DIETETICS IN GENERAL PRACTICE

by

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2nd Edition

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PREFACE TO THE 2ND EDITION

The new, second edition has been rewritten and enlarged. All the latest knowledge on the subject of dietetics has been incorporated. Several new chapters have been added, the most notable chapter being on foreign and Indian dietaries. Vernacular names of many food stuffs have been given. Indian conditions and circumstances have been kept in view in dealing with the subject. It is hoped that the book will meet the long-felt want of the medical profession in India.

MISSION CHURCH ROAD
DELHI
1st March 1946

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PREFACE TO THE 1ST EDITION

The subject of dieting and nutrition is of paramount importance in health as well as in disease. A vast majority of disease can be prevented and cured through proper feeding. Dietetics has now become a science and its importance in general medical practice is being recognised more and more every day. The subject has become fairly vast but the author has tried to give in nutshell all the practical knowledge regarding dieting in health and disease. It is hoped that the book will prove useful to medical men..

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CHAPTER I.

Dietetics, General Considerations.

Dietetics is the branch of science which deals with the knowledge about food and its application to human nutrition. It is a Science of comparatively recent growth. Dietetics is dependant upon the knowledge of Chemistry, Physiology and Pathology. In the ancient times when the knowledge of these branches was very poor. Dietetics was a mere guess work. Ancient Dietetics was crude and empirical. But the ancients were quite alive to the importance of the subject and attempted a detailed study of the subject inspite of their limitations. The oldest medical treatise of the world is Charaksanhita which has devoted several chapters to the study of this subject. Charak has classified vegetable and animal foods and given their properties. He has also laid down rules for eating in health and sickness at different times of the day and in different seasons. Some of the conclusions reached by Charak are found to be in harmony with the results of modern researches. For instance Charak describes meat as "giver of strength, vitality and builder of body", eggs are described as "giver of instantaneous strength and vitality and useful in wasting diseases, milk is described as "a tonic food, giver of life and vitality". Egyptians also paid

some attention to special feeding of the sick. Greeks also did their bit. Hippocrates knew the nutritive qualities of meat, eggs, milk and pulses. He attributed phthisis to deficiency in food. Galen recommended the use of human milk in phthisis. But the progress in Dietetics has been extremely slow and even in the beginning of the ninteenth century our ideas were little in advance of those held by the Greeks. In the middle of the ninteenth century Chemistry came to the aid of Dietetics and most of the foods were fairly well analysed in to their approximate principles. By the end of the ninteenth century metabolism of human body in health and disease became well understood. Energy value of foods was worked out. Value of proteins in body building and repair of tissues became recognised. Fuel value of carbohydrates and fats was understood. That diet was regarded perfect which was adequate in its caloric value and in protein, carbohydrate and fat. But in the twentieth century it was realised that this so called "perfect" diet was really deficient. The diet was found to be lacking in certain elements essential for health and growth and these elements were called vitamins and minerals. It was the work of Hopkins that brought the existence of vitamins to the notice of the medical world. Now this work has shown the fallacy of judging the adequacy of diet by chemical tests and has stressed

biological tests to be the only proper criteria to determine the adequacy or inadequacy of a diet.

This new knowledge has opened a new and vast chapter in medicine. Many diseases and many vague symptoms of ill health which baffled medical men before are now realised to be due to food deficiency. Food is the greatest factor in the physical and mental development of an individual as well as a nation. The Great English Physician Sir W. Osler called the food deficiency "as the greatest factor in the causation of disease next to infection or injury". Food deficiency directly causes diseases like beri beri, rickets etc., indirectly it causes lot of mischief by causing stunted growth and by lowering the body resistance to disease. The importance of food as factor in the health and well being of individuals as well as communities has been made clear by the work of several observers. Dr. William Hall examined at Leeds in 1902 the Jewish as well as the Gentile School Children of comparable financial status. Jewish children were found to be superior in phsique to Gentile children and the incidence of deficiency diseases like rickets and caries was much less in the former than in the latter. This was not due to any hereditary effect but was explicable by the dietary differences in the two communities.

Jewish families used greater amounts of protective foods in the shape of fruits, vegetables, fish, milk and eggs as compared to the Gentile families. Edward Mellanby has described the condition of the inhabitants of the Island of Lewis in the Heberdes. The inhabitants lived under dreadful unhygienic conditions, hudled together with their domestic animals in the same dark dingy room without any ventilation. The childern were not taken out of these rooms until they could walk. Taking these environments into consideration alone one would expect a high infant mortality and a great incidence of rickets and other disease. But the most striking fact was a low infant mortality, absence of rickets and carious teeth in the adult propulation. This is again explained by the dietary habits of the inhabitants. The children were breast fed and the staple diet of people was fish, oatmeal and eggs. McCarrison has attributed the poor physique of the Bengali student to the diet poor in proteins and calcium. W. R. Aykroyd compared the physical development of European boys, rice-eating South Indian boys and tapioca-eating boys of Travancore. Racially the latter two are of the same stock but the tapioca-eating boy is smaller and of poorer physique as compared to the rice-eating boy which in turn is inferior to the European boy. Tapioca is very poor in protein about 1-1·5%, consequently the

children are stunted in growth and inferior in muscular development. Superiority of physique of European boy is also based on dietary. Nicholis in Ceylon observed that within each racial group upper clan children are taller and heavier than the lower clan children. The level of average height and weight is associated not with race but with economic status and thus with diet.

The increase in average height of English boys during the last twenty years is due to better feeding.

Food deficiency plays a very important part in lowering the vitality and in lowering the resistance power to bacterial invasion. J. B. Orr cites the results of observations on two tribes in Africa. The diet of one of the tribes consisted chiefly of cereals, and was deficient in calcuim, vitamins A & D. The diet of the other tribe, consisting largely of milk, meat and raw blood, though defective in other respects was rich in those nutrients deficient in the former tribe. A survey of the incidence of diseases showed that in the tribe with the cereal diet, pulmonary conditions, bronchitis and pneumonia accounted for 31% of all cases of sickness, tropical ulcers 33% and phthisis 6% compared with a percentage of 4, 3, 1 respectively in the tribe with the meat, milk and raw blood diet. The incidence of some infective diseases like phthisis,

lupus, rheumatic fever and chronic middle ear disease as well as the mortality from these diseases is greater among the poor people represented by the unemployed and the unskilled labourers than among the well to do people. The usual diet of these poor people is rich in cereals but lack the so called "protective" foods such as milk, eggs and green vegetables. Miss Margaret McMillan found greater incidence of diseases like measels, scarlet fever, bronchopneumonia, middle ear disease and nephritis among malnourished children as compared with the well nourished children. Below the age of 3 years measels is a particularly deadly disease and there is suggestive evidence that the high mortality rate at this and older ages could be reduced by better nutrition of such children. In the early years of school life young children are already damaged goods. They frequently show evidence of previous defective feeding and lack of care in deformity of the bones of the limbs, chest and head, in bad dental structure and caries, in deafness, in discharging ears, septic tonsils and adenoids. Attempts have been made to come to an understanding of the mechanism involved in the lowering of resistance to bacterial invasion of organism on defective diet. Animal experiments have shown that following different ways are involved :—

Dietetics, General Considerations

(1) Deficient dietary causes changes in the composition of blood.

(2) Deficient dietary causes changes in the immunological reactions.

(3) The deficient dietary alters either the nature or the pathogenicity of the existing flora in the respiratory, intestinal and other areas in the body.

1. Deficient dietary causes changes in the composition of blood. A diet low in calcium and high in phosphorus results in a lowering of blood calcium and a rise of blood in organic phosphorus. Diet also causes changes in the alkalie reserve of the blood.

2. Deficient dietary causes changes in the immunological reactions. Agglutinin formation in guinea pigs and rats inocluted with B. typhosus has been studied. It has been noted that there is a significantly low titre in animals on a diet deficient in phosphorus and both agglutinins and bacteriolysins against B. typhosus in rats are reduced on diets deficient in vitamins.

3. The deficient dietary alters either the nature or the pathogenicity of the existing flora in the respiratory intestinal and other areas in the body. Reaction of the intestinal contents can be altered by food and such alterations cause changes in the bacterial flora.

CHAPTER II

Food and Metabolism.

Every living body produces energy in the form of heat and work or other forms, it undergoes wear and tear ; grows and reproduces. All these processes require certain materials and such materials usually introduced into the body through the alimentary tract are called food. From physiological point of view food has been defined by Hutchison as anything which when absorbed into the body through the alimentary tract is capable of one or more of three functions :—

(1) furnishing the body with materials from which to produce, heat, work or other forms of energy.

(2) enabling it to grow or to repair its wear and tear, and

(3) supply regulators, or the raw materials for regulators of its function of energy, growth and repair. To be more comprehensive and exact we may add the fourth function of body namely that of reproduction to it. So an ideal food should supply enough energy to the body;

it should give optimal growth and help in its repair and tear and reproduction.

The Chemistry of the food-stuffs. Food-stuffs are divided into the following classes :—

(1) Proteins like albumin, casein etc.
(2) Carbohydrates like starch, sugar etc.
(3) Fats like olive oil, ghee, etc.
(4) Vitamins.
(5) Inorganic sal.s.
(6) Water.

Proteins. Poteins are complex compounds of nitrogen built up from units called amino-acids. Life would be impossible without proteins as the main constituent of living cells is protein. Proteins build tissues, repair the wear and tear and supply energy. In the body protein is oxidised to carbon dioxide, water, urea, uric and other nitrogenous products.

Fuel value or energy value of proteins. Energy supplied by food stuffs to the body is measured in terms of heat and the unit choosen is called kilocalorie or large calorie (C). This unit is the amount of heat necessary to warm a kilogramme of water (2·2 lb.) through 1° Centigrade or to warm four pounds of water through

one degree Fahrenheit. Fuel value of proteins in the body is taken at 4·1 calories per gramme but outside the body fuel value of protein on complete oxidation is 5·6 calories. Body never completely oxidises the proteins, it stops short at urea and uric acid and so the fuel value inside the body is a little less than that on complete oxidation.

(2) *Carbohydrates.* They are composed of the elements carbon, hydrogen and oxygen. In the body all carbohydrates are changed into monosaccharides or simple sugars before being utilised by the body. Carbohydrates of food which can be utilised by the body as fuel are called "available" carbohydrates because some of the carbohydrates in food like "cellulose" are not utilised as fuel. These are termed "unavailable" carbohydrates. The fuel value of the avilable carbohydrates is 4·1 calories per gramme.

(3) *Fats.* Fats are glycerides of fatly acids like palmitic, stearic and oleic acids. Caloric value of fat is 9·3 calories per gramme.

(4) *Inorganic Salts.* The most important elements are Calcium, Phosphorus, Iron, Potassium and Sulphur. They are used in various ways in the body.

(5) *Vitamins.* They are complex organic

compounds necessary for physiological functions. Their importance has been realised only recently. Though they have no fuel value they are important in many ways and are indispensible to the body.

Food and Metabolism.

Value of food. Food value is judged by

(1) Energy value and
(2) Biological value.

Energy value of foodstuffs is measured in two ways.

(1) Direct calorimetry.
(2) Indirect calorimetry.

1. *Direct calorimetry* is also done in two ways :—

(*a*) Human calorimetry
(*b*) Food calorimetry.

(*a*) *Human calorimetry.* A human calorimeter is used. The apparatus measures the heat, carbondioxide and water given out by the subject in the calorimeter as well as the oxygen absorbed by the subject and from these data calculations are made.

Food Calorimeter. Food is burnt in an apparatus called Bomb Calorimeter and the output of heat is

measured. Calorie figures for fats and carbohydrates are identical in the case of human calorimetery and bomb calorimetery as in both cases they are oxidised completely. In the case of bomb calorimeter the calorie value of proteins is higher because the proteins are burnt completely while in human body the oxidation stops short at urea and other nitrogens body. Due allowance is made for this difference.

Indirect Calorimetry. This is done in two ways:—

(*i*) By gaseous exchange.

(*ii*) By food intake.

By Gaseous Exchange. The Benedict Rothapparatus is used and calculations of calories are made from the basal metabolism of the person. Indirect calorimetry by food intake. Tables are available giving the composition of food stuffs in the terms of protein, fat and carbohydrate. The average caloric values of protein, carbohydrate and Fat are 4·1, 4·1 and 9·3 calories per gramme respectively.

2. *Biological value.* This is determined by feeding experiments on laboratory animals. In a few instances large scale experiments on children and adults have also been done. The results of laboratory animals and of those on human beings have been more or less identical.

Metabolism.

A living body constantly needs energy. Even when the body is at complete rest, vital processes like those of respiration, circulation, secretion and excretion, production of heat go on inside the body and all these processes need certain amount of energy. In fact the body is never at rest completely during life. When body is moving about and doing work most of the vital processes are speeded up and consumes much more energy due to this factor as well as due to muscular work. All these vital processes in the body are grouped under one single term of metabolism and which is usually described under two heads:—

(1) Basal metabolism
(2) Total metabolism

Basal metabolism. It is the metabolism when the body is at complete rest. Enregy is needed only for the vital processes in the body and the body in this state consumes energy in the minimum possible quantity. This consumption of energy is measured in the term of heat loss. In human beings this is measured when he is in a state of complete rest some twelve hours after the last meal.

Measurement of basal metabolism. This is done in two ways:—

(1) Direct Human calorimeter. The subject is

placed in a human calorimeter and his output of heat is measured over a period of 1—2. hours.

(2) By Benediet Roth metabolism apparatus.

Factors influencing basal metabolism. These are:—

(1) Body surface	(4) Sex
(2) Weightt	(5) Endocrine
(3) Age	(6) Other factors.

(1) *Body surface.* The larger the surface of the body relative to its, the greater is the basal metabolism. For an adult male it is approximately 40 calories per square metre per hour.

(2) *Body Weight.* Heavier the body greater is basal metabolism but excess of tissues with little or no metabolism like skeleton and fat lowers the metabolism, while increased muscular element increases it. For an adult male it is approximately 11·3 calories per pound of body weight for twenty four hours.

(3) *Sex.* Basal metabolism of females is slig' t'y less than males. It is approximately 37 calories per square metre per hour.

(4) *Age.* Basal metabolism is diminished during old age. It is decreased by about 10% of the adult figure. Basal metabolism is greater during the period of growth.—infancy, childhood and puberty when the growing body cells are active. At the age of 6 years it is 60 calories per square metre and 50 calories per square metre near the age of puberty.

(5) *Endocrine factors.* Glands of internal secretion like thyroid, suprarenal and pitiutary have a great influence on basal metabolism. Basal metabolism is greatly increased in hyperthyroidism and decreased in myxoedema.

(6) *Other factors.* Basal metabolism is increased after exercise and cold bath temporarily. Sleep may lower it by 5–60%. It is decreased during the period of under nutrition.

For practical purposes the basal metabolism is calculated from the weight of the subject. An adult requires 12 calories per pound of body weight for each 24 hours, an infant about 40 calories per pound. Tables for different ages are prepared by workers like Holt.

Total Metabolism.

It is the total output of energy by the individual

during the twenty four hour period on full diet. This includes the following:—

(1) The energy out-put of the basal metabolism in addition to

(2) The energy out-put due to work done by the body in
  (*a*) standing up and going about,
  (*b*) any other mechanical work performed.

(3) The loss of heat in excreta.

(4) The endothermic loss in the growing young due to growth (Holt).

The loss of heat in the excreta varies from 150c—400c and for endothermic loss due to growth allowance is made from 200C—600C.

Maximum figures for both is during the period of puberty from 13–16 years. The energy out-put due to work done by the body is calculated in the following way.

(1) Energy out-put in standing up and going about. This is generally taken at 33 per cent higher on the basal metabolism.

(2) Energy out-put in the performance of mechanical

work. The energy out-put changes according to the quality of work.

(*i*) Light work: upto 75 calories per hour of work.

(*ii*) Moderate work : upto 75-150 calories per hour of work.

(*iii*) Hard work: upto 150-300 calories per hour of work.

(*iv*) Very hard work: upto 300 calories and upwards per hour of work.

For the sake of example let us calculate the energy output of an adult male weighing 140 pounds.

(1) Energy output at 8 hours basal metabolism $(140 \times 11{\cdot}3) \div 3 = 507$ calories.

(2) Energy output in 8 hours "up and about" at a rate of 33% higher = 676 calories.

(3) Energy output in 8 hours light work = 600 calories + energy output in 8 hours "up and about" = 676 calories.

(4) The loss of heat in excreta = 300 calories

Total 2759 calories.

Estimation of food requirement. An adult who is niether putting on weight nor loosing it is said to be in the

state of equilibrium as regards his metabolism. His total output of energy is measured by his total metabolism. The food must supply all this energy. This amount of food will represent the calorie intake but whole of it is not available to the body as certain amount of wastage is inevitable.

The actual edible amount of food should contain slightly more calories to compensate for it. This wastage is roughly about 10% of the total number of calories required. So edible amount should contain at least 10% more above the total metabolic needs. The food purchased consists of edible portion along with the non-edible portion in the form of skin seeds, husk, bone etc. The weight of non-edible portion depends on the nature of article of food and this should be taken into consideration while translating the edible portion into food purchased.

Climate. In tropical countries like ours the basal metabolism is usually 10% lower than in cold countries.

Calculation of food requirement for women and Children. It is assumed that women and children consume a definite fraction of what the average adult male eats. The adult male is counted as 1·00 "man value" or coefficient. The following scale of coefficients and caloric requirement is put forward as sufficiently accurate for India (Aykroyd).

Total Metabolism

Scale of Average caloric Requirements.

	Co-efficient	Calories required
Adult male (over 14)	1·0	2,600
Adult Females (over 14)	0·8	2,100
Child 12 and 13 years	0·8	2,100
Child 10 and 11 years	0·7	1,800
Child 8 and 9 years	0·6	1,600
Child 6 and 7 years	0·5	1,300
Child 4 and 5 years	0·4	1,000

These average requirements and co-efficients should very according to habits of life, climate etc. During pregnancy and lactation, however, needs of a women may equal or exceed those of a man. The League of Nation Commission assesses requirements during these periods as following :—

Pregnant woman	2,400 Calories
Nursing woman	3,000 Calories

CHAPTER III

Protein

Protein is essential for growth and repair of the wear and tear of the body and body building. The functions of protein in the body are:—

(1) It is essential for growth and repair of wear and tear of the body.

(2) It possibly supplies material for hormones and secretions and various biochemic processes.

(3) It is a source of energy. We have already seen that the caloric value of protein is 4·1c per gramme.

The most important functisn of protein is that it is needed for growth and repair of wear and tear and no other constituent of food can fulfil this function. Therefore one must examine the dietary for its protein content and be on the look out for any deficiency in this important constituent. If the supply of protein in the diet is sufficient for the function, of repair and growth. It is probably sufficient to supply material for hormones and secretions.

Protein

Though protein supplies as much energy as carbohydrate, it should not be used solely for this purpose. In this respect it is well replaced by carbohydrates and fats which are much cheaper forms of food constituents.

Protein is essential for living organism as it is the main constituent of protoplasm and it is manufactured only through the agency of living organism Plants can manufacture proteins from simple inorganic compounds containing nitrogen but animals can not. So animals depend on their supply of protein on plants. We human beings must get our supply of protein from plants or animals and there is no other alternative. Proteins are complex compounds of nitrogen and are built up from units called amino acids. There are about 22 a mino acids out of which ten are essential for human organism.

These ten must be supplied in diet as the body is unable to manufacture them. These essential Amino Acids are:—

(1) Arginine (2) Histidine (3) Isoleucine
(4) Leucine (5) Lysine (6) Methionine
(7) Tyrosine (8) Threonine (9) Tryptophane
(10) Valine.

A complete protein must supply all of these essential

amino acids and an adequate diet must contain a sufficient amount of complete proteins.

Biological value of Proteins

The most important function assigned to protein is to replace wear and tear of the body and to help its growth and the value of a protein is judged by its ability to perform these two functions. It is possible that efficiency of a protein may be different for these two functions but so far this has not been investigated. At present the only criterion used to judge the value of protein is by finding its power of replacing wear and tear of tissues protein and the results are obtained indirectly from animal experiments chiefly on rats. So far these studies have not been conducted on human beings and it is possible there may be some difference in the results. This value is called the biological value of a protein. This value may be different from its value of causing growth but the latter has not been worked out as yet. Below is given the table of biological value of proteins as discovered from experiments on rats. If a protein completely replaces the body protein its biological value is 100.

Food stuff.	Biological value.
Barley.	71
Cambu (Bajra)	83

Biological value of Proteins

Food stuff.		Biological value.
Cholam (Juwar)	...	83
Maize	...	60
Oatmeal	...	65
Rice raw polished	...	80
Ragi	...	89
Wheat, whole	...	76
Bengal gram	...	64
Black gram	...	51
Green gram	...	41
Soyabean	...	54
Potatoe	...	67
Sweet Potatoe	...	72
Coconut	...	67
Cashewnut	...	58
Gingelly seeds	...	78
Ground nut raw	...	56
Ground nut roasted	...	77
Meat	...	90—98
Egg	...	94
Milk	...	85

It will be seen at a glance that animal proteins like milk, and eggs have the greatest 'biological' value. Then come meat, fish and cereals followed by the pulses and lastly by nuts in the rear. Proteins of vegetable origin have lesser biological value than proteins derived from animal foods. No combinations of vegetable proteins can

support growth and give health and vigour as effectively as a mixture of vegetable animal proteins (Aykroyd). The vegetarian diet is apt to be deficient in proteins especially the animal proteins the so called first called proteins and this is much more so in India due to poverty, ignorance and prejudice. Children and females during pregnancy and lactation require relatively larger amount of animal protein in their diet than the adult and this kind of protein deficiency is the chief cause of undermining of the national health and stamina. It is good that those communities in India who call themselves vegetarians use milk and milk products but the chief defect in their diet is that there is only one source of animal protein namely milk. There is no other alternative of supply of animal protein and thus members of such communities are bound to suffer from protein deficiency if sufficient amount of milk or its casein products are not taken. This is the case quite commonly with the females of these communities.

Daily Requirement of Protein

The first essential of an adequate diet is that it should contain proper amount of protein especially the animal protein.

We must determine this adequate amount of protein for an adult male, female and child. The amount of

protein required by an adult is determined by a series of nitrogen balance experiments in which the daily intake of nitrogen in the form of protein and output of nitrogen in the urine is compared. When the body can remain in nitrogen equilibrium indefinitely on a certain quantity of protein that quantity is the amount of protein required by the person for protein equilibrium. For a normal male adult in health this amount has been found to be about 50-52 grammes of protein per day (Leitch and Duckworth). This is said to be the minimal figure and in order to safeguard against upsets Sherman suggests to include an extra fifty% over and above this amount. His figure comes to about 78 grammes of protein per day or approximately 1 gramme of protein per kilogram of body weight. This has been accepted by the League of Nations Technical Commission on Nutrition. But all the workers are not agreed on this point. Some regard this amount as too low and among these Susskind is the foremost man, who carried out a long series of experiments himself. According to other workers this figure is fairly high and even smaller amounts of protein not of high biological value may suffice. Hindhede fixes it as 22 grammes of protein daily. Chittenden also made studies on himself and found that 36 grammes were sufficient while Corrymann has maintained his own efficiency on an intake of 61 grammes per day. However

Sherman's figure of 1 gramme of protein per kilogram of body weight may be taken as the standard amount of protein required daily. This amount will generally make up 10% of the total calorie requirement of the body.

Amount of First Class Protein. Here also there are differences of opinion. The British Medical Associations' Nutrition Committee suggested that at least 50 grammes of protein for an adult should be proteins of animal origin. This is about two thirds of the total amount of protein per day. The Advisory Committee on Nutrition of the Ministry of Health accepted as 50% of the total daily amount to be of animal origin as sufficient. The minimum amount of animal proteins needed in a tropical climate is twenty percent of the total amount of protein per day (Aykroyd).

2. ***Protein requirement of Females.*** An adult female will, proportionately to an adult male, require less food and less protein if pregnancy and lactation are not considered. Her co-efficient of energy needs is 0·8 of the adult male, and so her protein requirement is also in the same ratio. During pregnancy and lactation much more protein is required and during this period the amount of protein should be at least double the amount ordinarily needed by a female.

Daily Requirement of Protein

3. *Protein requirements of Children.* More protein is needed during the period of growth, *i.* e. in childhood and near puberty. It has been found by observation of the rates of growth on different amounts of protein that in children of 1½-2 years 2·5 grammes of protein per kilobody weight is sufficient for growth only in the warm part of the year. Another extra 1 gramme per kilogram is needed in winter and even then the growth is not optimal. The Russian Workers suggest 4 grammes per kilogram of body weight daily for children. Figures of League of Nations are slightly lower and both are given below for the sake of comparison :—

Age	League of Nations Grammes per kilo	Russians Grammes per kilo
1—3 years	3·5	4·0
3—5 years	3·0	3·8—3·5
5—15 years	2·5	3·5—2.5
15—17 years	2·0	2·6—2·5
17—21 years	1·5	2·5—2
Adult	1·0	2

Digestion and assimilation of Proteins.

In the Stomach. Digestion of proteins in the stomach takes place with the help of pepsin-hydrochloric acid mixture. Acid meta proteins are formed first which

are converted into peptones through the stages of primary and secondary proteoses.

In the duodenum. Trypsin of pancreatic juice acting in an alkaline medium breaks down the proteins to the stage of polypeptides and may liberate some amino acids. Bile salts help in this process.

In the small intestine. Erepsin of the success entericus completes the breakdown of polypeptides into amino acids which are absorbed from here and conveyed to the liver. If carbohydrate has not been taken at the same meal these amino acids are used as fuel; such a protein is not used by body for repair of the wear and tear. These amino acids are deaminated by the liver and changed into glucose or fatty acids. Glucose is burnt to carbon dioxide and water. Fatty acid is changed in to butyric acid; thence to aceto acetic acid and if carbohydrate be available to carbondioxide and water. During the process of deamination ammonia is also formed; this is changed into urea by the liver. Urea is excreted in the urine. Phosphoric and sulphuric acids are also formed which are excreted in urine as inorganic sulphates and phosphates.

If amino acids are accompanied by carbohydrate they

are not deaminated by the liver and are allowed to pass into blood stream to the body tissues. This problem was studied by Cuthbertson and Munro. They think that the presence of carbohydrate in the liver depresses the activity of the deaminizing ferments of the liver. The amino acids are used in the wear and tear of the tissues. It is probable, too, that this applies also to the amino acids during the period of growth, pregnancy and convalescence. These amino acids built tissue proteins.

The metabolism of proteins in diet undergoing this deamination and used for fuel purposes is called exogenous protein metabolism. End products of exogenoue protein metabolism are:—

(1) *Urea.* It may be regarded as index of protein intake.

(2) *Ammonia.* But its excretion depends not on the nitrogen intake but on reaction of the blood.

(3) *Inorganic Sulphate.* They depend on protein intake.

(4) *Some Phosphates.*

Endogenous protein metabolism. Proteins, partaking in wear and tear meet different fate. They are changed into creatine and purin bodies. Creatine is excreted in the

urine as creatinine which is true index of endogenous protein metabolism if creatine in the diet (meat) is not present. Purine bodies (adenine and guanine) are oxidised by the liver into xanthine and hypo xanthine and further in to uric acid which is excreted in the urine as urates. So uric acid like creatinine is true index of endogenous protein metabolism if purin bodies are not present in the diet. Neutral Sulphur in urine also represents endogenous protein metabolism.

Uric Acid.

(1) The total output depends on the purine content of the diet.

(2) Protein ingestion stimulates the uric acid output

(3) Raising the caloric value of the diet increases the uric acid output.

(4) Carbohydrate increases the uric acid output. Blood uric acid is increased in gout. Ingestion of purin-containing food has no effect on the blood uric acid in normal persons but is raised in gout. The exact relationship is not known.

Specific Dynamic action of Proteins. The ingestion

of proteins stimulate the body metabolism for about 3 hours to the extent of about 20%. This is called the specific dynamic action of proteins. The energy so liberated is wasted in the form of heat. This specific dynamic action is absent under the following conditions:—

(1) When the temperature of the air surrounding the body is low. The heat liberated due to specific dynamic action is utilised to keep the body warm.

(2) When growth and wear and tear of tissues occur.

This action is much more marked in the case of animal proteins like meat. Vegetable proteins have very little specific dynamic action. Fats and Carbohydrates also have specific dynamic action but is not marked.

Protein deficiency. Protein deficiency is wide-spread. Perhaps it is the commonest food deficiency next to caloric deficiency. It is wide-spread in well-to-do countries like Great Britian where it has been estimated that from 18-20 million persons consume inadequate quantity of protein (B. M. J. 29th Oct. '38). What to say of India, which is the land of poverty, ignorance and prejudice. It is much more common in communities whose main diet is

vegetarian. Vegetarian diet has got cereals pulses and nuts as sources of protein and milk is usually included in it. Certain cereals like rice and tapioca which are eaten commonly in South India have low percentage of protein. Proteins of pulses and nuts are inferior and are not absorbed by the body to the same extent as animal proteins. There may be 20 percent—30 per cent wastage of these proteins due to non absorption in intestine. If these vegetable proteins are supplimented with sufficient quantity of milk, nothing more is left to be desired. But only one source of animal protein makes the choice very limited. Protein deficiency is much more common amongst females of certain communities in which dietary discrimination is made in the diets of males and females. These communities purposely deny milk to their girls as they are considered a liability.

Effects of Protein deficiency. A condition of an abnormal lowering of the plasma protiens or Hypoproteinaemia is now recognised as a definite clinical entity. The causes include malnutrition, loss of digestive capacity, defective intestinal absorption, liver disorder, or increased loss of proteins through suppuration, nephrosis, haemarrhage or burns; also after operations and anaesthesia. The general manifestations are those resulting from a disturbance in water distribution—namely oedema of the subcutaneous

tissues and various viscera. The condition may be acute, subacute or chronic. In adults protein deficiency causes feeling of tiredness, lassitude, irritability, easy fatigue and lowered resistance to infection. The convalescence is prolonged and healing of wounds is delayed. But the effects are much more disasterous during childhood. Children brought up on protein deficient diet are less lively, are stunted in growth and poor in muscular development. They easily fall prey to various infections. Protein deficiency affects mothers in several ways. The incidence of premature births is increased in mothers whose diet is poor in proteins. Margaret-I-Balfour and Shakuntla K. Talpade compared the diets of mothers in South and North India. In the south the diet was generally poor in proteins and the incidence of premature births was found to be 101 per 1000 as compared to that of 37 per 1000 in the north where the diet of mothers is comparatively rich in proteins. The infants born of mothers with diet deficient in proteins were weak. The morbidity and maternal mortality was greater in mothers with diets deficient in proteins. The secretion of milk in mothers is also decreased and the milk is of poor quality. The labour is difficult.

Supply of Proteins

Animal Proteins.

Milk. Milk is a very good and important source

of first class proteins. Cow's milk contains from 3%—3½% proteins or roughly 1 gram per ounce. Minimum daily quantity of milk for an adult should be at least 20 ounces or 1¼ lb. which will supply 20 grams of animal protein, the minimum safe amount of animal protein. Separated milk is equally good for this purpose and same is the case with curds or lassi. Milk is the main source of protein for majority of population in India. Whey is a very poor source of protein only about 0·82% Butter milk is a good source 3%—3·7%

Cheese is a good source of protein but is not much used in India. It contains protein from 15—35%.

Khowa or Mawa or Rubri are very good sources of proteins and have concentrated form of milk proteins. Dried milk, condensed milk or casein preparations are on the market.

(*a*) *Eggs.*—Eggs are the second best source of protein and in certain respects proteins of eggs are superior to even milk proteins. Eggs are especially useful in wasting diseases, for children, for pregnant and lactating mothers and during puberty. One egg of hen supplies from 6-7 grams of proteins. Egg powder may be used. Eggs do not contain purines.

Supply of Proteins.

(*b*) ***Fish.***—Fish is a good source of protein which is present from 8—15%. Cooked fish contains protein from 11%—23%. Preserved fish from 14%—33%. Dried fish 80%.

(*c*) *Meat.* Meat contains proteins from 10%—22%. Cooked meat contains proteins from 22·3%—35%.

2. *Vegetable* ***Proteins.*** This comes from three classes of products:—

(1) Pulses including peas, beans and lentils.

(2) Nuts.

(3) Cereals.

The Pulses. The pulses are rich in proteins, but they are not readily digested by the stomach. If pulses are cooked thoroughly and prepared in fine division about 80% of the proteins are absorbed by the intestine Nutritive value of proteins of pulses is inferior to that of cereals. These proteins are deficient in sulphur and so are not so useful for body building as animal proteins. The quantity of proteins vary from 17%—25%. Soya bean is of special importance as the protein content is very high about 35%. Soya bean protein has high Biological value and it approaches the animal protein in this respect.

Horvath says "The Soya bean protein is a complete protein containing all the essential amino acids necessary for the building up of the proteins of the human organs." Milk prepared from soya bean has been used sueccessfully in infant feeding.

Pulses are never eaten alone. They are eaten with cereals. An adult roughly consumes 503 grammes of cereals daily which if made of any cereal other than rice would give about 50 grams of proteins of cereal origin. He should add about 2-3 ounces of pulses in order to give additional supply of 12-18 grammes of protein. If the cereal consumed is rice the supply of protein in cereal diet is lowered to 40 grammes. He should add about 3-4 ounces of pulses in order to give an additional supply of 18-24 grammes of protein.

2. *Nuts.*—Nuts are very rich in fat and fairly rich in proteins. The proteins of nut are inferior to those of pulses and cereals Nuts are rather indigestible. They contain from 15%—25% proteins. Ground nut contains about 26% of proteins and is a very good supplement to increase the protein content of diet. 8 oz. of ground nuts will supply about 25 grammes of protein. Almonds are also useful but very costly.

Supply of Protein.

3. *Cereals.*—Cereals are eaten mainly for the supply of carbohydrates but they are good source of proteins as well. Proteins of cereals are of high biological value and they are present to the extent of 8% – 12%. Rice is the poorest and oats the richest cereal as regards protein content. An adult gets about 40-50 grammes of protein daily from his cereal diet.

CHAPTER IV

Vitamins

Vitamins do not provide any energy to the body but are essential for health and growth. They act as catalysts. Vitamin deficiency is wide spread and it is the chief cause of deficiency diseases like scurvy, beri beri, rickets etc., Apart from this, minor deficiency is very common and is a common cause of chronic ill health. It was the work of Hopkins in 1912 that first revealed the importance of vitamins. Vitamins are divided into two classes:—

(1) Fat soluble vitamins

(2) Water soluble vitamins.

Fat soluble vitamins are fairly stable to heat and are not washed out in water. They can be stored in the body and so it takes a long time for their deficiency to develop.

Water Soluble Vitamins. They are rather easily destroyed by heat and oxygen. They cannot be stored in the body and so their deficiency arises more quickly than is the case with fat soluble vitamins.

Fat Soluble Vitamins.

1. *Vitamins A.* The vitamin A has been isolated in the form of pale yellow crystals. Chemically it is an alcohol and is closely related to the yellow pigment of plants called carotene which was first isolated from carrots. There are three isomers of carotene, alph, gamma and beta—the last one being the most active. One molecule each of alpha and gamma carotene is changed into one molecule of vitamin A by liver while one molecule of carotene beta gives rise to two molecules of the vitamin. The vitamin A and carotenes are insoluble in water and are therefore not washed out of food stuffs by boiling or steaming. They are soluble in oils, fats and liquid paraffin. Prolonged use of liquid paraffin may wash out vitamin. A from food and hinder absorption in the intestine giving rise to vitamin A deficiency. Light and air accelerate the destruction of vitamin A but vitamin A or carotenes are stable to heat and they can stand various cooking processes such as frying, roasting if done in the absence of air. But rancidity of fats and oils destroy it. The vitamin A can be stored in the body especially in the liver.

Functions. Vitamin A is essential for growth, reproduction and lactation. It is essential for the health of epithelial structures which degenerate in its absence and are attacked by germs. If young rats are placed on a diet complete, so far as we know except for vitamin A, they

stop growing, all die within a few months with multiple infective lesions affecting different parts of the body, most commonly the eyes, the ears, the lungs, the nasal sinuses and the gastro intestinal tract. If vitamin A is added to the diet before the infection is well established, cure follows rapidly. The infective lesions associated with vitamin A deficiency have the following characteristics:—

(1) They apparently begin in mucous membranes and epithelium.

(2) They are of a subacute or chronic type.

The use of vitamin A as a therapeutic agent in acute infections is limited. As a prophylactic against infection and especially against chronic infection it is much more effective.

Neural structures which are of the same origin as epithelial structures also degenerate on account of vitamin. A deficiency especially the optic and auditory tracts.

Vitamin A deficiency. (1) The earliest changes occur in skin. A peculiar dry skin condition with spinous papules is seen at the side of the hair follicles mostly at the extensor surfaces of the extremities, shoulders and lower part of the abdomen. There is no pain, no itching or tenderness. This is called phrynoderma or toad skin.

(2) Loss of lustre and wrinkling of the conjunctiva takes place Cornea becomes dull and hazy.

In more advances cases Keratomalacia and Xeropthalmia are seen.

(3) In moderate deficiency, the tongue and oral mucosa are pale and anaemic, smooth but unglazed. There is increased suspectibility to pyorrhoea alveolaris.

(4) The opinion, that deficiency of vitamin A is the cause of night blindness has been recently shown to be clinically unsound.

Daily requirements. It used to be estimated at 3000—4000 international units a day for adults. But recently it has been found that for adults not less than 5000 units a day are needed. During pregnancy and lactation and for a growing child 6000—8000 units a day are essential. Green vegetables, tomatoes; carrots; sweet potatoes the dairy products and liver carry such abundant supplies of this vitamin that there is little reason why anybody on a normal and varied diet should suffer from the deficiency of vitamin A. But in childhood and during pregnancy and lactation use of vitamin A Concentrates are necessary.

Sources of Vitamin A.

(1) Animal sources.

(*a*) Fish liver oils. Richest source is Halibut liver oil 30,000—360,000 unit per gramme or 1200—14,400 units per drop.

Cod liver oil or Shark liver oil } 500—2000 units per gramme.

(*b*) *Animal Liver.* From 70—1,600 units per gramme.

(*c*) *Egg yolk.* 40 units per egg.

(*d*) *Raw Milk.* 170—4,000 units per pint, pasteurized or boiled milk looses ¼—⅓ of its vitamin.

Butter 735—5,700 units per oz.

Cheddar Cheese. 1,560 per oz.

2. *Vegetable sources.* Richest source in the vegetable kingdom is red palm oil. 400—500 units per gramme.

International units per 100 grammes or 3½ ozs. or one serving.

Raw Tomatoes.	14,000—36,000	units.
Carrot (Gajar Hindustani).	2,000—4,500	„
Cabbage (Hind-Band Gobi).	2,000	„

Sources of Vitamin A.

Celery (Ajwan Ka Patta).	5,800—7,500	units.
Coriander (Dhaniya Hara).	10,570	,,
Gram leaves (Channa Ka Sag).	6,700	,,
Spinach (Palak).	2,500—5,000	,,
Lettuce (Salad).	2,200	,,
Mint (Pudina).	2,700	,,
Amaranth (Cholai).	2,500—11,000	,,
Drumstick (Saijan).	11,300	,,
Agathi (Agasthi).	9,000	,,
Curry leaves (Gandhela).	12,600	,,
Fenugreek (methi Ka Sag).	3,900	,,
Khesri leaves (Khesri Ka Sag).	6,000	,,
Mango ripe (Am).	1860—4,800	,,
Pappaya Ripe (Papita).	2020	,,
Apricots fresh.	1800—2300	,,
,, *Dried.*	5100—5500	,,
Orange juice.	300—400	,,

Vitamin D.

Under the term "Vitamin D" are included several substances which function in the proper utilization of calcium and phosphorus. These substances are derivatives of sterols which acquire anti-rachitic properties when exposed to ultra violet light. The two most important substances are those produced by the irradiation of ergosterol and of

7–dehydro cholestrol. Calciferol is vitamin D2 prepared by the ultra-violet irradiation of ergosterol and possessing a potency of 40,000 I-u of anti-rachitic activity per mg. Cholestrol is present in many animal fats and associated with it in the natural state are small quantities of 7-dehydro cholestrol. Activated 7-dehydro-cholestrol is the chief form of vitamin D present in fish-liver oils. This substances is termed D3.

Function. The chief function of vitamin D is to lower intestinal alkalinity and so to lessen the formation of unabsorbable calcium soaps. Calcium compounds are made more soluble and absorbable. Some say that the function of vitamin D is to prevent excretion of calcium by the gut. It also helps the formation of carbonate and phosphate of calcium in bones.

Deficiency. Vitamin D deficiency in early childhood or in the faetus causes defective formation of milk teeth which become more susceptible to decay in later years. The permanent teeth begin to calcify at birth and continue up to the eighteenth year, through out all this time the diet ought to be rich in vitamin D. A diet rich in vitamin D will greatly increase the resistance of the decaying teeth and may stop the carious process. In institutions when vitamin D was added to the diet, the incidence of caries

was found to be much reduced and it stopped the spread of caries and actually caused the healing of carious process. Gross deficiency causes rickets in children (From 6 months —18 months) and osteomalacia and delayed rickets in adults. Minor deficiency is common. Mild rickets is often overlooked. Rickets is fairly common in India. Though there is plenty of sun shine in this country still there is need of adequate supply of vitamin D in diet. Excessive use of cereals also causes rickets as the cereals are rachitogenic. Already the diet of mothers is deficient in proteins and rich is cereals and this factor contributes to the incidence of osteo malacia in mothers and to the rickets in their offspring. Osteo malacia is extremely common is orthodox Hindu females who do not take fish or eggs and are married at early age. Repeated pregnancies at short intervals with poor diet are the great factors Children in villages though they get good milk, are often seen with gross rickets as milk is a poor source of vitamin D, and eggs are not used. The safest rule is not to depend on the sun shine or on diet for the supply of vitamin D and it must be given the form of fish oils, or synthetic preparation through out the period of growth, pregnancy and lactation. It is better to continue through out life even after the puberty as sometimes vitamin D deficiency mainfests itself in the middle age or old age in

the form of vague rheumatic pains, osteoporosis or fragility of bones. Symptoms of mild rickets are:—There is delay in closure of the anterior fontanelle. Cranial bossing with typical bossing with square large head may be the only bony manifestation. Dentition is delayed. There are marked evidences of muscular hypotonia and weakness. Symptoms of dyspepsia, flatulence diarrhoea, nervous irritability and fretfulness, natural softness and pallor are present.

Craniotabes—*i.e.* asymmetrical softening of the cranial bones in the region of the lamboid suture—is a reliable sign in infants older than 3 months but is rarely found after the sixth month. After the fourth month the most reliable sign, when scurvy could be eliminated was a definite enlargement of the costo-chondral junction of the fourth to the tenth rib. This sign is of particular value since once having appeared, it would last for weeks or months after all xray signs of activity had gone. Thus the appearance of either of these clinical manifestations was regarded as evidence of rickets even with a normal x-ray picture. Similarly, even in the absence of clinical signs, the appearance of definite radiological changes was regarded as diagnostic. Children under 1 year show the greatest liability to the disease. If a child can avoid the

disease during the first two years of life it will probably remain free after that age even without special prophylactic measures.

"Osteomalacia" Early symptoms are pains in the back, and region of hip. Gradually walking becomes difficult and pelvis becomes deformed.

"War Osteo pathy" or "Hunger Osteomalcia" made its appearance among the peoples of Central Europe shortly after the war of 1914—18. This disorder was characterized by pains in the back, groins and legs and by a somewhat characteristic gait, by difficulty in climbing stairs and by some tenderness of the bones. Marked deformities of spine and the extremities, multiple fractures were seen. It is related to osteomalacia. Requirement. About 500 units daily for children. Adults not known.

Sources.

Ordinary mixed diet is practically devoid of Vitamin D. Vitamin D is formed in the skin by the action of sunlight and absorbed into the body but no quantitative estimate is possible.

Richest source is Halibut liver oil 200—4000 units per gram.

Cod liver oil or Shark liver oil 60—300 units per gram.

Edible Fishes 470—1,000 units per 100 grammes or 3½ oz. or per serving.

Milk 0—57 units per pint.

Butter 0—113 units per ounce average 34.

Eggs 22—75 units per egg.

Vitamin E.

Vitamin E is an oil-soluble substance occurring in oil from wheat-germ, rice-germ cotton seed and maize and in green leaves. Wheat-germ oil is the most commonly used source. Alphatocopherol, an alcohol isolated from wheat-germ oil has been found to have Vitamin E activity to a marked degree. Other fractions Beta-tocopherol and gamma-tocopherol have also biological activity of Vitamin E but in lesser degree. The vitamin is remarkably stable to heat, light, air, and to chemical agents generally, but is rapidly destroyed by rancid fat.

Deficiency of this vitamin causes in male animals permanent degenerative changes in the testicular germinal epithelium, and in female animals, although fertilization can occur, intra-uterine death and resorption or abortion of

the foetus occurs. Vitamin E acts either directly, or through the anterior pituitary in increasing the formation of the corpus luteum hormone, progesterone.

Dose wheat-germ oil 5 ccm. or 75 m. a-tocopheral 2 mg. 3 mg.

Therapeutic Uses.

I. It is useful in the treatment of sterility and habitual abortion in the female when organic diseases like gonorrhoea, syphilis etc. can be excluded. It is also used in case of threatened abortion or premature separation of the placenta, and even in the later months success has been obtained.

P. Voget Moller cured 17 out of 20 cases of habitual abortion by giving 40 drops of wheat-germ oil three times daily (III to VII of pregnancy) for 4 months followed by a dessert-spoonful of wheat-germ three times a day.

Somewhat extensive claims have been made that neuromuscular diseases, such as muscular dystrophies, amyotrophic lateral sclerosis, progressive muscular atrophy, bulbar paralysis and tabes dorsalis were benefited by the administration of Vitamin E. Recent clinical reports have not substantiated earlier claims.

In few cases of fibrositis results were encouraging but further trials are necessary to evaluate its utility.

Vitamin K.

Vitamin K is widely distributed in nature. It is found in the green parts of plants. It is present in alfalfa, spinach and sprouting oats. It is also present in putrifying extracts of fish meal, rice bran or casein and is formed in human intestines by bacteria. Several substances possess Vitamin K action activity. That obtained from alfa alfa is a yellow oil known as Vitamin K, with the formula 2 - methyl - 3 - phytyl - 1 : 4 - naphthoquinone. Another one isolated from sardine meal or fish meal is K_2 with the formula 2 : 3 - difarnesyl - 1 : 4 - naphthoquinone. Synthetic compound 2 - methyl - 3 - hydroxy - 1 : 4 - naphthoquinone is three times more potent than the natural vitamin. It is yellow crystalline substance. It is oil soluble and is given by intramuscular injection. With oral administration bile salts must be present in order to assure absorption of the synthetic product. 2 mg. thrice daily raises the prothrombin content to normal in 24—48 hours.

For injection 2 - methyl - 1 : 4 - naphthohydroquinone - 3 - sodium sulphonate, a water-soluble compound (2 mg. in 1 cc.) is used. Intravenous injection is useful for checking active haemorrage, which is controlled within 1½—3 hours;

and a normal prothrombin level is reached in 24—48 hours, but it falls rapidly ; an intramuscular injection maintains the normal level for some days.

Another compound, 2 - methyl - 1 : 4 - naphthohydroquinone disuccinate is also water soluble, although unstable, and must be dissolved just before intravenous injection, its action is much more rapid but less sustained.

Vitamin K will not influence haemorrhage unless this arises from a deficiency of prothrombin in blood. Administration of Vitamin K daily to mothers for a week before labour increases the prothrombin content in the blood of the new bo n infant, which may also receive 2 mg. soon after birth as prophylactic against haemorrhagic disease of the new born.

Vitamin K is essential for the normal synthesis of prothrombin in the body. Liver plays a very important part in this synthesis. A damaged liver as in cirrhosis of the liver is unable to utilise Vitamin K and so there is prothrombin deficiency. Vitamin K needs bile salts in the intestine for its absorption and so there is defective absorption of Vitamin K due to deficiency of bile salts in the intestine in obstructive jaundice and biliary fistula and consequently prothrombin deficiency. The chief indications at present

for the use of Vitamin K are the haemorrhages associated with obstructive jaundice and haemorrhagic disease of the new born. It is of no value in hemophilia, purpura and intrinsic diseases of the blood forming organs or as a non-specific haemostatic. It is given to mother 12 and 4 hours before delivery for:—

1. In case of maternal toxaemia.
2. In premature labour.
3. Difficult or instrumental delivery.
4. When breast feeding is not possible.
5. When any cerebral symptoms develop during the first few days of life.
6. In cases of haemorrhagic diathesis, icterus gravis neonatorum and anaemia.
7. When an operation is necessary on the new born.

Vitamin B Complex.

This has now been divided into several factors of which the following are of medical interest:—

(1) Vitamin B1
(2) Vitamin B2 (Lactoflavin, riboflavin).
(3) Nicotinic Acid (P. P. Factor).
(4) Vitamin B6 or Pyridoxine.
(5) Pantothenic Acid.

Vitamin B Complex.

Vitamin BI. Thiamine hydrochloride or aneurine. hydrochloride. It was first isolated from rice bran or yeast. Now it is prepared synthetically also. It is a crystalline powder highly soluble in water and so is very easily washed out of, vegetables, fruits and cereals on washing and boiling. The vitamin is stable in the presence of weak acids but not to alkalies and so baking powders destroy the vitamin in bread. It can stand boiling temperature of water but higher temperatures destroy a good deal of it. It is very susceptible to certain preservatives like sulphites used for food and the vitamin is destroyed even in acid medium in their presence. Raw milled rice looses most of its vitamin and the process of cooking which consists in repeated washing, boiling and throwing away of water in which it is boiled takes away the remaining vitamin. Parboiled rice still contains appreciable vitamin BI as during the process of parboiling most of the vitamins gets inside the grain but the vitamin is lost by repeated washing and throwing away of water in which rice is boiled. If potatoes are boiled in its skin the loss is only 10% if boiled after peeling the loss is as much as 25%. Similarly highly processed meat, canned meat, preserved meat looses most of their Vitamin B content. Vitamin B, deficiency develops fairly quickly in a few days to 3 months at the most.

Function. Vitamin BI along with other members of this group is concerned with carbobydrate metabolism. When B_1 is deficient, the further breakdown of pyruvic acid, an intermediate product of the break-down of glucose fails and so excessive pyruvic acid accumulates in blood. A diagnostic test for thiamine deficiency is the estimation of the level of pyruvic acid in blood. Liver deficient in Vitamin B_1 can not store glycogen (Tonnuti and Wallraff). The defective glucose metabolism consequent of B_1 deficiency causes degeneration of the myelin sheaths of nerves. BI also helps the tissues to take up oxygen which is so essential for certain tissues like nervous and cardiae muscle. It is essential for the normal activity of central nervous system and heart. In alcoholic neuritis, alcohol captures the vitamin before it can get to the nervous system which needs it for utilization of oxygen.

Vitamin B_1 deficiency may result:—

(I) From diminished intake as faulty diet, alcoholism, food fads, poverty or vomiting.

(2) From diminished absorption in achlorhydria, cancer of stomach, diarrhoeas, coeliac disease, ulcerative colitis, dysentery etc.

(3) From increased demands due to pregnancy, lactation, prolonged fever, increased metabolism due to

hyperthyroidism, excessive muscular work, excessive carbohydrate intake.

Minor deficiency causes anorexa, loss of weight, mental and cardiovascular disturbances.

Six patients were kept for 88 days on a diet deficient in Vitamin B_1. The more active subjecrs were the first to experience symptoms. These were depressed mental states, generalised weakness, dizziness, backache, soreness of muscles, palpitation, dyspnea and precordial distress on exertion, insomnia, anorexia, nauses, vomiting, loss of weight, atony of muscles, slight roughness of the skin, faint heart sounds, lowered blood pressure and bradycardia when at rest with tachycardia and sinus arrhythmia on exertion. In all cases physical activity greatly decreased. There were also seen states of apathy, reawakening of psychotic trends, difficulty of thought and memory, photophobia, headache, abdominal distention, sensation of cold and heat, burning of the soles of the feet, numbness of the legs, fatigue of ocular muscles, tenderness of the muscles of the calves and depressed tendon reflexes.

Changes in the heart, and oedema were not seen. Anaemia did not develop and there was no redenning of the skin or of the tongue. Capacity for work fell progressively.

Degree of debility induced was impressive. It resembled in early stages neurasthenia and anorexia nervosa in later stages. Symptoms of the beri beri as oedema, cardiac dilatation and peripheral pain were absent. So in all cases of neurasthenia, deficiency of vitamin BI should be kept in mind.

Major forms of deficiency result in polyneuritis. Muscle tenderness, painfull para-esthesias and symmetrical "glove and stocking" sensory loss as well as weakness of the limb are present. During the early stages of the disease neuritis of a single peripheral nerve (*e. g.*, Ulnar) or loss of tendon jerk, may be the only clinical manifestation. Oedema, tachycardia or congestive heart failure, dermatitis, glossitis, stomatitis or diarrhoea may also occur. These symptoms are seen typically in Beri Beri.

Gross deficiency causes the well known disease beri, beri which is common in rice eaters. Beri beri in adults is characterised by anorexia, neurasthenia oedema, cardiac dilatation and peripheral neuritis with muscle tenderness, para-esthesia and "glove and stocking" sensary loss. There is glosstis or diarrhoea also.

In infants the disease beri beri takes a peculiar form and often proves fatal. Symptoms develop shortly after breast feeding. There are attacks of vomiting, abdominal

pain accompanied by crying or screaming, diarrhoea and abdominal distension or of vomiting, stiff-ness of neck and extremities and convulsions. In more severe cases, dyspnoea, cyanosis and running pulse are present. The attacks often end fatally, but in case of survival the infant passes into the chronic state with symptoms of oedema, oliguria, aphonia, constipation, meteorism, neck retraction, enlargement of liver, and right side of the heart, loss of weight retarded growth and marasmus. Due to oedematous condition of the respiratory tract, these infants are very liable to broneho-pneumonia which proves fatal. The acuteness of symptoms is dependent on the amount of milk ingested; consequently overfed babies are more liable to acute attacks and to sudden death. These symptoms disappear on the cessation of breast feeding and reappear on the resumption of breast feeding by mother suffering from Beri beri.

Minor deficiency in Vitamin BI is quite common even amongst the wheat eaters. The symptoms are not typical and any combination of symptoms may occur. There is vague ill health, neurasthenic symptoms, symptoms of anorexia nervosa and constipation, increased sense of fatigue and insomnia.

Daily requirement. For children and adults about

300—600 I. U. daily. Much more during pregnancy and lactation. The requirement is increased with increased consumption of carbohydrates.

Sources.

The richest source is yeast.

Food yeast (Torulopsia utilis)	2 mg. per 100 gms.
Medicinal yeast	16 mg. per 100 gms.

(2) *Cereals.* These are next best sources.

Cambu (Bajra)	110	units per 100 grams. or 3½ oz.
Barley (Jau)	150	"
Cholam (Juwar)	115	"
"Kootu"	300	"
Oat Meal	325	"
Ragi	140	"
Rice raw, home pounded	60	"
Rice raw milled	20	"
Rice paraboiled, milled	70	"
Wheat	180	"
(2) *Nuts. ground nuts raw*	300	"
Walnut	150	"
Almonds	80	"
(3) *Pulses. Gram (chana)*	100	"
Blackgram (urd)	140	"

Sources.

Green-gram (mung)	155	units per 100 grams.
Lentil (masur Kidal)	150	,,
Peas-dried (mattar)	150	,,
Red-gram (Arhar Kidal)	150	,,
Soya bean	300	,,
(4) *Leafy vegetables.*		
Cabbage (Gobi)	50	,,
Drumstick (Saijan)	70	,,
Fenugreek (Methi)	70	,,
Garden Cress (Halim)	50	,,
Lettuce (Salad)	90	,,
Spinach (Palak)	70	,,
(5) *Roots and Tubers Beet root*	70	,,
Carrot (Gajar)	60	,,
Parsnip	105	,,
Radish (muli)	60	,,
Artichoke (Hattichak)	75	,,
Cauliflower (Gobi)	110	,,
Pumpkin (Kaddu)	200	,,
Tomatoe	23	,,
Turnip (Shalgam)	40	,,
(6) *Fruits Banana*	50	,,
Raisins	75	,,

Animal Foods are poor in vitamin B1.

Meats contain about 227 units per lb. but		
pork is exception	1500	„
Fish	140—380	„
Milk	130	units per pint.

Nicotinic Acid. (Niacin)

Nicotinic acid is also called P. P. factor or pellagra preventing factor. Gross deficiency results in pellagra. It is one of the constituent of cozymase which is necessary for alcoholic fermentation (hence presence of nicotinic acid in yeast) and muscle glycolysis. Cozymase of blood decreases in both pellagrins and diabetics. This is increased by giving nicotinic acid. Nicotinic acid dilates the blood vessels. Nicotinic Acid amide has similar action as nicotinic acid but does not cause dilatation of blood vessels. Prepared synthetically—nicotinic acid occurs in colourless, adourless crystals soluble in water.

Nicotinic Acid deficiency. Gross deficiency causes pellagra. Pellagra occurs in epidemic and endemic forms in maize eaters. Four systems of the body are affected by pellagra :—(1) Cutaneous

(2) Gastro intestinal

(3) Cardiac

(4) Nervous.

Nicotinic Acid (Niacin).

Any one or more than one system may be involved.
(1) Cutaneous. Skin lesions develop very insiduously.

There is pigmentation and roughness over the parts exposed to sun such as face, extremities and extensor surfaces of the limb. Butterfly patch on the nose and cheeks.

(2) Gastro intestinal. There is stomatitis and glossitis. The mucosa is pigmented on the inner sides of cheeks, inner side of lips and sides and tip of tongue is inflammed. There is angular stomatitis also. There is anorexia, abdominal distension, vague abdominal pains and chronic diarrhoea.

(3) *Circulatory.* There is low blood pressure, tachycardia and anaemia are present.

(4) Mental symptoms are common and these may be present alone. There may be loss of memory, delirium mania, depression and neurasthenic symptoms. Sub-clinical and atypical cases are very common. Urine shows porphyrinuria and a positive test in a suspected case of pellagra having constitutional disturbances will clinch the diagnosis, but the test may be negative in early mild cases and in cases in which only skin manifestations are present.

Daily requirement is from 25—50 milligrams a day for an adult.

Sources are : — milk, liver, lean meat, fish eggs, tomatoes, green peas, green vegetables.

Nicotinic Acid Centent of Foods
(M. Swaminathan)

	Common. English name	Nicotinic acid (mgm. per 100 grams)
	Barley, whole	4·5
	Barley, Pearl	2·8
	Maize	1·4
	Millet	1·8—3·2
	Oat meal	1·4
	Rice, raw, husked	4·6
	Rice, raw, milled	1·2
	Rice, raw, hand pounded	2·4
	Rice parboiled, flakes or puffed	3·8—4·1
	Rice polishing	28·4
	Wheat, whole	5·0
	White flour	1·0
Pulses		1·3—2·6
Nuts.	*Ground nut*	14·1
	Gingley seeds	4·4·

Nicotinic Acid Centent of Foods
(M. Swaminathan)

Common. English name	Nicotinic acid (mgm per 100 grams).
Mustard	4·0
Almond	2·5
Cashew	2·1
Vegetables	0·2—1·2·
Curry leaves	2·3
Neem, tender	1·4
Roots and Tubers	0·4—1·2
Fruit	0·1—0·4
Milk and eggs	0·1—0·2
Meat	2·8—6·8
Fish	1·0—3·9
Liver	13·8—15·3
Yeast dried bakers	45·0
Yeast, dried Brewers	43·1—62·5
Other yeats	6·5—26·1

Riboflavin

It is also called Lactoflavin, Vitamin G or Vitamin B2. It occurs as an orange yellow crystalline substance which is soluble in water. It is relatively highly heat-stable. The phosphate of this vitamin, when conjugated with protein forms a flavo-protein which acts as a 'respiratory

enzyme' of the tissues, and probably facilitates the conveyance of hydrogen. Vitamin B2 appears to be essential for the maintenance of normal fat metabolism. Deficiency causes the following manifestations:—

1. *Cheilosis.* Earliest sign is a greying of the mucous membranes at the angles of the lips. At the same time there may be denudation of the mucous membrane at the point of contact. Fissuring appears and extends radially out in to the skin.

2. Buccal Mucosa. It may reveal greyness, thickening and puckering and followed by desquamation of the epithelium.

3. *Glossitis.* The tongue is usually smooth with the papillae reduced in prominence. It is of a purplish red color.

4. *Nasal Lesions.* Fissuring at the nasolabial folds is seen. There may be ulceration at the border of the external nares and nasal septum.

5. *Seborrheic Accumulations.* There may be an accentuation of the seborrheic deposits in the nasolabial folds and over the nose.

6. *Desquamation about the eyes and ears.*

7. *Interstitial Keratitis.* Slit lamp reveals vascularization of the cornea, symptoms of "itching, burning and a sensation of the roughness of the eyes with mild photophobia" are present.

8. *Vaginal and Penile Lesions.* Erythematous lesion of the penis, scrotum and vagina may be present. There is tendency to superficial ulceration.

Riboflavin in Angular Conjunctivitis. Morax-Axenfeld bacillus is found in abundance in smears from cases of angular conjunctivitis. Drops of zinc sulfate act as specific for this condition. The action of zinc, accord-to Duke-Elder is not a bactericidal one, for the diplobacillus grows well in a culture-medium containing zinc; the zinc acts by inhibiting the proteolytic ferment secreted by the bacillus and so rendering it impotent. O.P. Verma treated 20 cases of the angular conjunctivitis by riboflavin. No local treatment was given. There were other signs of riboflavin deficiency present in the majority of cases. The angular conjunctivitis disappeared and the smears became negative.

(I. M. G. June 1944)

Deficiency of riboflavin is one of the most prevalent forms of uncompensated avitaminosis.

Normal daily adult requirement is 2. 7—3 mg.

Riboflavin in Typical Foods: Micro-grams per 100 grams.

Food.	(Sherman) Range
Animal foods.	
Pork	225—255
Kidney	1700—2200
Liver	1800—2600
Milk	195—240
Eggs	280—420
Egg white	150—300
Egg yolk	380—750
Grains.	
Wheat, entire	100—220
Wheat, germ	600—800
Vegetables Fruits.	
Banana	45—80
Broccole	200—500
Carrots	75—125
Kale	400—600
Lettuce	100—240
Spinach	250—400
Tomato	28—62
Orange	37—63
Dried yeast	5000—6000

Therapeutic Uses.

1. Riboflavin cures all the lesions produced due to its deficiency.

2. It has proved very useful in eye diseases.

Akenphascopia. "Twilight blindness" is blindness which appears at night fall or in bad artificial illumination. This is different from night blindness in the fact that it does not improve with Vitamin A. It is rapidly cured by riboflavin.

Keratitis Rosacea. Johnson and Eckardt treated 86 cases of keratitis rosacea with 2 mg. of riboflvin daily 32 were rapidly cured.

Corneal Ulcers. S. Barrenchea et al treated 109 cases of corneal ulcers with riboflavin. The initial dose was 3 – 5 mgrs. and then 2 mgrs. daily for a week given intravenously, Orally it may be given in doses of 5—6 mgrms. In 70 p. c. of these cases, subjective symptoms disappeared in 2—3 hours in the case of small ulcers and 4—5 days in the more serious cases Healing takes place after 12—14 hours with an average of 70 hours.

Trachoma with Pannus and Corneul Ulcers. Riboflavin with sulfanilamide gives much rapid and better results than sulfanilamide alone.

Parenchymatous Keratitts. It is of great help.

Pemphigus. Riboflavin is also usefnl in this skin disease.

Other members are:—

(1) Pyridoxine. (2) Pantothenic Acid. (3) Biotin.

Pyridoxine (Vitamin B6)

Pyridoxine is the chemical name for Vitamin B6 (2 methyl - 3 - hydroxy - 4, 5 - dehydroxy methyl - pyridine). Like other members of the Vitamin B Complex, pyridoxine (administered both as the base and the hydrochloride) is relatively free from toxic action.

Deficiency of pyridoxine. A syndrome characterized by extreme nervousness, insomnia, irritability, abdominal pain, weakness and difficulty in walking dramatically disappeard after intravenous administration of pyridoxine. It increase reticulocytes and leucocytes when administered intravenously in doses of 50—100 mg. of crystalline pyridoxine in sterile normal saline. These effects were specially noted in cased of macrocytic anaemia associated with pellagra or pernicious anemia.

Joliffe treated 15 cases of Parkinson's syndrome 50—100 mg. of pyridoxine hydrochloride was adminis-

tered intravenously either every day or every other day. Out of this group 6 improved. Rigidity was lessened and there was increase in strength but tremor was not affected.

Pantothenic Acid.

The "filtrate factor" is identical with pantothenic acid. Liver and kidneys of various animals are the richest source of pantothenic acid. Then come rice, bran, baker's yeast, egg folk, dried skimmed milk and alfa alfa. It is also essential to human nutrition and its function is associated closely with that of riboflavin.

Biotin.

It is the latest member of vitamin B complex. It is the latest vitamin to be synthesized. The deficiency of this vitamin produces a syndrome characterized by a scaly dermatitis, ashen-grey pallor, tongue lesions, paraesthesiae, nausea and changes in the blood picture. Avidin which is present in the white of egg produces a complex with the biotin of the diet and prevents its absorption and thus causing deficiency. A case of an old retired labourer is reported who suffered from an exfolia ive dermatitis and mild conjunctivitis for several years. Since adolescence he had been extremely fond of raw eggs. The lesion did

not correspond to that due to deficiency of nicotinic acid, riboflavin, patothenic acid or pyridoxine. The serum biotin was also low. Under a liberal diet and injections of methyl ester of biotin, the dermatitis largely disappeared and the serum biotin returned to normal.

Good sources of biotin are milk, meat and liver.

Imbalance of Vitamin B Factors

Several workers have observed that excessive dosing with one particular factor of the B complex may induce secondary deficiencies in the other factors of B Complex. Richards conducted experiments on rats and found that excessive use of vitamin Bi and chalk produced B6 or pyridoxine deficiency Bi alone in excess also produced B6 deficiency. This shows that vitamin Bi given indiscriminately as a dietary adjunct by large oral doses or by injection in the treatment of various diseases is not free from risk. Braendstrap treated a chronic dyspeptic treated with ulcer diet, and gave large injection of vitamin Bi totalling 220,000 I. U. in 3 weeks. Signs of pellagra developed which were treated with a preparation containing the entire B Complex. Various toxic effects of vitamin Bi are also noted by different workers. Steinberg (1938), who treated cases of chronic arthritis with large dose of vitamin Bi records that in a few patients vitamin Bi

therapy caused "typical lesions of herpes zoster," irritation of the peripheral nerve plates, and spasm of smooth muscle. The pain and irritation ceased when vitamin Bi therapy was withdrawn. Leitner (1943) noticed unfavourable effects in 2 cases treated with pure vitamin Bi over long periods. In one case the symptoms resembled those of thyroid over-action and included insomnia, headache, giddiness and palpitation. Similarly treatment of cases of pellagra with nicotinic acid produced symptoms of pyridoxine deficiency such as extreme nervousness, insomnia, irritability abdominal pain, weakness and difficulty in walking. All the symptoms disappeared within 24 hours after an injection of 50 mg. of pyridoxine. The present results emphasize the need for caution in any attempts to improve the diets by indiscriminate use of large supplements of single synthetic B vitamins.

[B. M. J. 31-3-45 (433—436)]

Vitamin C.

Acid Ascorbicum, Cevitamic Acid is in colourless, odourless crystals with an acid taste, extracted from vegetable sources or prepared synthetically. Soluble in water. Vitamin C regulates the cellular oxidation reduction system and plays a part in the formation of red cells; deficiency of the vitamin increases the fragility of the

capillary walls, lowers resistance to acute infections, and may originate cataract, probably it is necessary for carbohydrate metabolism as a 'redox potential' producer.

Vitamin C is more readily destroyed by heat or oxidation than any of the other vitamins. Ordinary cooking destroys most of the vitamin C. Vitamin C, disappears on keeping, even when food stuffs are kept in a refrigerator, and, in general, it is absent from all preserved food stuffs. The only foods in which this vitamin can be preserved are the juice of citrius fruits, preserved tomatoes.

The vitamin C present in orange or lemon juice is peculiarly stable, and loses little of its potency after being heated to 100°c for an hour. The vitamin is also preserved in dried orange juice.

The major deficiency from this vitamin results in scurvy with characteristic symptoms of sore and bleeding gums, diarrhoea, oedema and haemorrhages, which may occur in any part of the body. There is also great muscular weakness. Minor deficiency is common. There is a hemorrhagic tendency from the gums and mucous surfaces along, with fatigability, weakness and dyspnea on exertion. There may be anorexia and anemia and under nutrition.

Gingivitis is considered by some to be a subscorbutic

state and acute gingivo-stomatitis and chronic gingivitis are considered by some as not due to inefficient dental hygiene or lack of the same but to vitamin C deficiency. Vitamin C in doses of 50—75 mgm. per day abolished subclinical scurvy.

Therapeutic Uses—

(1) It is useful in the prevention and treatment of scurvy or subclinical manifestations of scurvy.

(2) Toxic manifestations of Arsenical or Gold therapy such as dermatitis, haemoptysis, petechiae are well treated by intravenous administration of vitamin C in doses of 100—200 mg.

(3) Habitual abortion. H. Hosemann et al found that hypovitaminosis C is a factor predisposing to abortion and its administration is valuable in the prevention of abortion.

(4) Vitamin C deficiency has been found in the majority of cases of peptic ulcer. Correction of vitamin C deficiency in such cases helps the healing of ulcer.

(5) Large doses of vitamin C benefit cases of Psoriasis and Lupus erythematosis.

(6) Vitamin C helps healing of wounds and fractures, intestinal ulceration and is useful in surgical patients.

(7) A marked deficiency exists in infections like pneumonia, tuberculosis, rheumatism, whooping cough, fever, typhoid fever etc. It should always be corrected.

(8) It has been found useful in incipient cataract.

(9) In congestive heart failure. Vitamin C increased the output of urine and decreased oedema.

(10) Paroxysmal haemoglobinuria. successfully treated with ascoibic acid, '300 mg. intravenously for several days.

(L. Armentans Nature, Lond I, 910 1936).

(11) Idiopathic Methaemoglobinaemia. James Denny et al treated two cases with 100 mg. of ascorbic acid daily. Improvement was apparent after one week. Sodium bicarbonate 2 dr was given each day. Hawley et al found that sodium bicarbonate raised the renal threshold for ascorbic acid and reduced the amount excreted.

(B. M. J. June 12, 43).

(12) It is of value in the treatment of hypochromic anaemias, of capillary fragility in children, and of capillary haemorrhages in the skin and conjunctiva.

Requirement.

For children and adults about 30—50 mgm. of vitamin C per day.

Vitamin C.

Daily requirement 50—75 mg. per day. In acute infection requirement is increased.

Sources.

Richest Source is Amla, Indian goosebery

	800	mg. per 100 gms.
Rose hips	400	"
Black currents	200	"
Guava	300	"
Haw	500	"
Leafy vegetables		
Amaranth (cholai)	173	"
Cabbage (Bund gobi)	124	"
Celery (Ajwan Patta)	62	"
Coriander (Dhaniya)	135	"
Drumstick (Saijan)	220	"
Parsley	281	"
Spinach (Palak)	48	"
Cucumber (Khira)	18	"
Roots and Tubers		
Beet root (Chukander)	88	"
Other vegetables		
Bitter gourd (Karela)	88	"
Cauliflower (Gobi)	66	"
Turnip (Shalgam)	43	"

Fruits

Lemon	40
Lime	63
Mango	24
Orange	68
Pine apple	63
Tomato	32
Straw berry	52
Melon	50
Raspberry	30
Banna	15
Peppers	30
Radish	20
Watercress	76
Germinating grains	10—15

Cooked vegetables

Asparagus	19—40	(boiled)
Beet root	20	(boiled 1—2 hours)
Cabbage	10—22	(boiled 30 minutes)
Potato	4—15	(boiled, peeled)
Spinach	30	(boiled 30—40 minutes)
Tomatoes	7—21	(*Canned*)
Turnip	18	(boiled)

CHAPTER V.

Inorganic elements.

Mineral salts enter into the structure of the body and take part in various biochemic processes in the body as catalysts. Calcium enters into the formation of skeleton and also acts as catalyst in the form of inonised calcium to maintain the function of voluntary and involuntary muscles. Iron is needed for the formation of haemoglobin, Iodine for the formation of thyroxine. Potassium is essential for living cells and so on. The most important minerals with which we are concerned are :—

(1) Calcium. (2) Phosphorus. (3) Sodium.
(4) Potassium. (5) Iron. (6) Chlorine.

Calcium.

The function of calcium. (1) It enters into the formation of bones and teeth. (2) It acts as a catalyst. Calcium circulates in the blood in the form of ionised calcium to the extent of 10 mg. per 100 c.c.

Vitamin D and parathyroids are concerned in the calcium metabolism.

Parathyroid is concerned with maintenance of calcium, balance in the blood. Deficient activity of parathyroids

results in tetany as the result of the fall of calcium blood levels. If calcium supply is not sufficient or if it is not absorbed by the body, the blood level of calcium is maintained by the mobilisation of the calcium from the bones. Calcium is absorbed from the small intestine in the form of inorganic salts and the presence of vitamin D is essential for its absorption. The absorbed calcium which is in excess over the body needs is excreted in the urine. Anything which hinders absorption in the small intestine may bring about calcium deficiency as excessive use of purgatives or diseases of intestine like sprue, coeliac disease.

Calcium deficiency. During infancy the rapidly growing skeleton and building of good teeth require a food supply rich in calcium. The need for calcium continues through out the period of growth and so there is a very real "Calcium problem" in human nutrition which is not easily realized. Todd and his associates found a large proportion of skeletons subnormally calcified; showing the necessity for greater intake of calcium. Fragility of the bones of the aged and their vague rheumatic pains are also due to calcium deficiency. This shows calcium deficiency may arise at any age of our life. Rickets, osteomalacia, osteoporosis, fragility of the bones, dental caries and defective dental development all result from

calcium deficiency. A low calcium diet in experimental animals was found to support growth and apparently normal health in the first generation but not in the subsequent ones. The second generation animals were undersized and there was diminished reproductive activity, while the third generation showed premature senility.

Calcium requirement of male adults. Leitch has calculated it to be 0·55 gramme daily. Sherman has suggested 0·68 gramme and to be on the safe side an extra allowance of fifty percent should be added to either figure which comes to ·825—1·0 gramme. During adolescene between the ages of 15—18 years the quantity should be double; about 2 gramme per day.

Calcium requirement of females. During pregnancy the maternal diet should contain much more calcium than is needed for an adult female in order to supply the calcium for the bones of the faetus otherwise the calcium from the bones of the mother is demobilised to supply the calcium for the bones of growing faetus. The amount needed is 1·6 grammes daily and this has been accepted by the League of Nation's Technical Commission. If vitamin D is given in large doses say 3000. I. u. daily a smaller amount of calcium may be enough. The diet of females is very commonly deficient in calcium in India. The main

source of calcium is milk and females are apt to suffer from deficiency of calcium if their milk intake is poor, as the demands of calcium on maternal organism are great. Early marriage is an important cause of calcium depletion.

Children are born at the age of sixteen or eighteen years when bones are not yet fully developed and it has been commonly seen that after only two pregnancies which generally come in quick succession the maternal body becomes depleted of calcium, her bones become soft and osteomalacia results. Subsequent pregnancies deplete the system still more, the pelvic become contracted and all the consequences of deformed pelvis result.

During Lactation. The human breast milk contains from 0·126—0·717 grammes of calcium per litre. Assuming a secretion of 1 1/2 litres of milk daily the maternal body provides 0·2—1 gramme of calcium to the baby and in addition she needs for herself an extra 0·75—1 gramme daily.

Calcium requirement of children. Leitch found that at birth the body contains 10 grammes of calcium per kilogramme of body weight. In order to maintain it the calcium intake should be 0·2 gramme daily at 1 month and 0·52 gramme daily at 6 months. Translated in the term of breast milk it is 30 ounces daily at 1 month and 57

ounces at 6 months. After that the calcium requirement increases with age till it reaches 1·5 gramme daily at the age of fourteen. About the age of puberty it is about 2 grammes daily.

Cow's milk is four times richer in calcium than the breast milk but sufficient retention of calcium on cow's milk is more difficult as it is absorbed much less. Treatment of the milk with acid or with calcium chloride and feeding it to the baby with Vitamin D will overcome this difficulty.

The calcium deficiency in diet is very wide spread only the wealthiest classes obtain enough of it.

Sources.

Milk. Human breast milk (0 126—0·77 gms. per litre).

Cow's	120	mg.	per	100 grms.
Soft cheese	722	"		"
Hard cheese	810	"		"
Buffaloe's milk	210	"		"
Goat's milk	170	"		"
Curds	120	"		"
Skimmed milk	120	"		"
Mawa or Khoa	650—990	"		"

Leafy vegetables

Agathi	1130 mg. per 100 grams.
Amaranth (Cholai)	500 " "
Gram leaves (Channa ka sag)	340 " "
Carrot leaves (Gajar ke patte)	340 " "
Cabbage (Bund gobi)	30 " "
Celery (Ajwan Patta)	230 " "
Coriander (Dhania)	140 " "
Curry leaves	810 " "
Drumstick (Saijan)	440 " "
Fenugreek (Methi)	470 " "
Garden cress (Halim)	360 " "
Khesari Leaves	160 " "
Lettuce (Salad)	50 " "
Mint (Pudina)	200 " "
Parsley	390 " "
Rape leaves (Sarson ka sag)	370 " "
Spinach (Palak)	60 " "
Soya leaves (Soya)	180 " "

Nuts and oil seeds

Almond (Badam)	230 " "
Cashew nut (Kaju)	50 " "
Gingely seeds (Til)	1450 " "

Sources.

Ground nuts (Mungphali)	50 mg.	per 100 gms.
Pistachio nut (Pista)	140 „	„
Walnut (Akhrot)	110 „	„
Cereals		
Bajra	50 „	„
Barley	30 „	„
Cholam	30 „	„
Kootu	70 „	„
Maize	10 „	„
Oatmeal	50 „	„
Rice	10 „	„
Wheat	50 „	„
Bengal gram	190 „	„
Black gram (urd)	200 „	„
Green gram (mung)	140 „	„
Peas dry	70 „	„
Rajmah	260 „	„
Rawan	80 „	„
Red gram (Arhar)	140 „	„
Soya bean	240 „	„

Meat, fish, fruit and most vegetables contain useless amounts. Hard water contains good amount. In many vegetables it is in the form of calcium oxalate which is not absorbed. For practical purposes the dependable source is milk and milk products.

Phosphorus.

Phosphorus. Functions are :—

(1) It enters in the formation of skeleton a d other tissues.

(2) Acts as catalytic and

(3) As a buffering agent.

In urine alone the loss as a buffering agent is $\frac{3}{4}$ gramme daily which must be made up. The body needs phosphorus more than calcium. In adults if the diet is deficient in food, body can draw upon store of phosphorus in bones but in growing animals this is not possible and so low phosphorus intake limits growth. The body obtains its supply of phosphorus from organic as well as inorganic compounds. Organic phosphorus in one particular combination found in cereals is useless for the body. This is called the phytin phosphorus. If calcium is adequate in diet then phosphorus will be adequate too. Generally there is no deficiency of phosphorus in the diet.

Sources.

Richest sources are milk and eggs. Then come meat and fish.

Milk contains from	95—100	mg. per	100 grms.
Soft cheese	481	„	„

Iron.

Hard cheese		544	mg. per 100 grams.	
Eggs	per egg	140	"	"
Meat		250—425	"	"
Fish		210–425	"	"
Fruits and vegetables are poor sources		20—100	"	"

Cereals are rich sources.

Wheat	190 mg. of available phosp. per 100 grms.			
Rice	60—110	"	"	"
Oats	220	"	"	"
Barley	124	"	"	"

Iron

Iron is needed for haemoglobin. The iron is absorbed from the small intestine in the form of ferrous iron. Once absorbed it is not excreted in to the large intestine but is stored in reticuloendothelial system and is gradually utilised when needed. An adult male needs 15 mg. of iron daily and this need is covered by the quantity absorbed from an ordinary mixed diet. But the case of female is different. After puberty she looses about 40 mg. of iron during each menstrual period. As a result the haemoglobin level of females is between 70—90. During pregnancy she hands over some 400 milligrams to the faetus and another 500 mg. to the placenta and may loose some

in postpartum haemorrhage as well. So anaemia is *common among females and her requirements are estimated* at 20 mg. per day.

Infant. Infant is born with high haemoglobin level 145 which falls during the first six months as milk is a poor source of irom. It may fall to 70% or 40%. Child's haemoglobin level begins to rise when it starts taking solid food.

Sources.

Rich sources are meat, cereals and nuts. Fruits and vegetables are poor sources.

(1)	Nut	*Almonds*	4·23	mg. per 100 grammes.
		Coco nut	2·08	,,
		Ground nut	2 04	,,
		Walnut	2·35	,,
(2)	Cereals	*Barley*	3·6	,,
		Wheat	3·0	,,
		Oatmeal	3·8	,,
		Rice	2·0	,,

(3) Fresh fruit and vegetable from 1·25—3 mg, ,,

Eggs	per egg	1·58 mg.
Liver	5·2—6·9 mg.	per 100 gms.
Meat	2·0—4·5 mg.	

But it is not known how far food iron is available to the body.

Iodine.

Iodine is needed but in very small amounts. The daily iodine requirement of adults is between 100—200 micro grams. Sufficient quantity of iodine is essential for normal growth. Swiss statistics show that boys receiving icdine grew on rhe average 7 mm more than untreated boys and put on 200 Gms more of weight. The mean weight at birth of infants whose mothers were receiving iodised salt was 100 Gms greater than that of controls.

Iodine deficiency causes goitre which is commonly found in hilly regions. Iodine intake of a given place is dependent largely on the soil iodine. The amount of iodine in the local drinking water may be regarded as a measure of the iodine content of the soil, and consequently of the fruits, grains, grasses and vegetables grown in the region. This also determines the amount of iodine in milk, eggs and other food.

Thyroid gland is connected with iodine metabolism, Iodine deficiency and consequently goitre may arise when increased demands of Iodine take place such as during the period of puberty, pregnancy and lactation,

infectious diseases, high calcium intake or in defective absorption of iodine.

0·02 % of sodium iodide is added to the common salt and used as table salt. This is called iodised salt and has proved successful in the prophylaxis of goitre. In Machigen during the period from 1924—1935 the incidence of goitre decreased about 75—90 after the use of iodized salt.

Sources.

Chief sources are seafish and edible seaweeds Fish contain from 120—200 microgrammes per 100 grammes.

Watercress and onion also few microgrammes per 100 grammes.

Sodium Chloride

1. Sodium Chloride is essential for the production of the hydrochloric acid in the gastric juice.

2. It is essential for osmosis in the body fluids.

3. It enables the blood to carry carbon dioxide.

4. It is necessary for keeping the ionisation of calcium in blood.

Sodium Chloride.

Cortex of the suprarenal gland governs the excretion of sodium salts by the kidneys. Some of the symptoms of Addison's disease are due to the direct loss of sodium chloride from the blood. There may also be excessive loss of sodium chloride in excessive perspiration, in diarrhoea and vomiting. The symptoms are muscular weakness, cramps, dyspnoea after exertion, langour, mental confusion and drowsiness. Usually enough amount is taken in an ordinary diet. Animal preparations are rich in sodium chloride. In dropsy there is increased sodium retention and diet poor in sodium chloride is given.

Potassium.

Potassium is found in greater abundance in the body cells than in the surrounding fluid. It is necessary for building of tissues. There is no evidence that there is any possibility of potassium deficiency in diet. All vegetable foods are rich in potassium. A diet low in potassium is given in Addison's disease.

Acid Base Equilibrium.

Proteins are oxidised to give rise to sulphuric and phosphoric acid which are excreted in the urine and increase its acidity. When the metallic elements present in food (containing much fruit and vegetables) are oxidised

in the body they give rise to bases which change the reaction of urine to alkaline. Foods having preponderance of basic ions in their ash are called basic foods and those which have acid ions are called acid foods. Citric and malic acids are oxidised in the body to carbon dioxide and water.

In a healthy person there is no need to balance the "basic and the acidic foods but when the kidneys are diseased the diet must be adjusted according to the power of kidneys to excrete 'acid' or 'basic' urine.

Some organic acids like benzoic acid and oxalic acid are not oxidised into body into carbon dioxide and water. On excretion they make the urine acidic. Oxalic acid as calcium oxalate is present in spinach, beet leaves, sorrel, cabbage, tomatoe, lettuce and strawberries.

Benzoic acid is present in cranberry and whortleberry and is excreted as hippuric acid.

CHAP VI.

The supply of energy yielding foods.

I. Carbohydrates. Carbohydrates are the compounds of carbon, hydrogen and oxygen. They are divided into three classes:—

(1) Monosaccharides or the hexoses such as Glucose fructose and Galactose.

(2) Disaccharides. Formed by the union of two monosaccharides such as maltose, sucrose and lactose.

(3) Polysaccharides. In which many monosacch arides unite such as starch, glycogen and dextrin.

These forms of carbohydrates are utilised by the body and are called 'available' carbohydrates, cellulose, pectin and others are also carbohydrates which are not digested and utilised by the body. These are called "unavailable" carbohydrates or "roughage". Their function is to stimulate the alimentary canal by their mechanical action or chemical irritation of their decomposition products by bacteria in the large intestine. Carbohydrates are the chief source of energy and are abundantly present in vegetable foods

Digestion and metabolism of Carbohydrates.

Digestion. (I) Ptyalin of the saliva digests only cooked starch. It acts in an alkaline or neutral medium or in slightly acid medium. Starch is changed in to maltose. This takes place in stomach.

(2) The hydrochloric acid of the gastric juice hydrolyses cane sugar to maltose.

(3) Amylase of the pancreatic juice acts on cooked or uncooked starch and changes in to maltose. It acts in an alkaline medium and its action is enhanced by bile salts in the duodenum.

(4) Succus entericus contains three ferments.

i. Invertase changes cane sugar in to glucose and fructose.

ii. Maltase changes maltose in to glucose.

iii. Lactose changes lactose in to glucose and galactose.

Absorption. The absorption of glucose and galactose takes place by the active intervention of intestinal epithelium. Fructose is gradually converted in the lumen of the small intestine into glucose. Glucose together with galactose and some fructose reach the liver where the two are also

changed in to glucose. Most of the glucose is changed in to glycogen and stored in the liver as such, some, however, passes through the liver in to the systemic circulation. In normal persons with an ingestion of 150—200 gms. of glucose there is no trace of sugar in the urine. But there are cases in which after an ingestion of 100 gms. of gulcose, glucose is excreted in the urine in quantity sufficient to reduce a copper solution. These are the cases of diminished tolerance of sugar.

Carbohydrate storage in body. About 500 gms. of glycogen are stored in human body. About 100 gms. in the liver, the rest in the skeletal muscles.

(1) Muscle glycogen is formed from the circulating blood sugar, the process is helped by insulin.

It can not be readily converted in to glucose.

Liver glycogen. It is readily converted in to glucose. Surplus sugar is changed in to fat and stored in the body. Glucose is oxidised through the stages of lactic acid and pyruvic acid in to carbon dioxide and water by the help of enzymes and coenzymes involving vitamin B_1, riboflavin and nicotinc acid. If vitamin B_1 is not present in sufficient amount, the oxidation stops at pyruvic acid. The following glands are concerned in the metabolism of

carbohydrates:— (1) Liver (2) Pancreas (3) Pituitary (4) Thyroid (5) Suprarenals. Adrenalin, Thyroxin, vasopressin from the posterior lobe and hormone from the anterior lobe are antagonistic to insulin.

Role of liver in carbohydrate metabolism.

(1) It changes fructose and galactose in to glucose.
(2) It changes glucose in to glycogen and vice versa.
(3) It can form glucose from proteins and fats.

Role of Pancreas.

The internal secretion is insulin —

(1) It facilitates the combustion of glucose by the tissues.

(2) It stimulates the formation of glycogen in the liver and muscles.

(3) It inhibits liver from forming glucose from non-carbohydrate sources.

The Role of Pituitary.

(1) The extracts of the posterior lobe acts antagonistic to insulin.

(2) The anterior pituitary through the diabetogenic hormone acts mainly on the liver stimulating it to form glucose from glycogen and non-carbohydrate sources. It

inhibits the utilization of glucose by the tissues. It increases deposition of fat in the liver at the expense of the fat depot of body. It has also glycotropic factor which diminishes the action of insulin.

Metabolism in Diabetes mellitus.

(I) Carbohydrate metabolism.

i. Glycogen formation in the liver and muscles is depressed.

ii. Combustion of glucose by the tissues is depressed. Less oxygen is absorbed, the respiratory quotient is lowered from the normal value of 0·8—0·85 to 0·7.

(2) Fat metabolism. Fats are not oxidised beyond the stage of B. oxybutric and acetoacetic acids which cause ketosis and are buffered by the sodium bicarbonate of the plasma. The tendency to acidaemia is dealt with in the following ways :—

i. Compensatory hyperpnoea.

ii. Excretion of highly acid urine.

iii. Increased ammonia excretion.

The fat of the depots is mobilised in excessive amounts.

There is excess of fat in the blood and blood cholestrol rises.

(3) Protein metabolism. After the carbohydrate stores of the body have been depleted, the proteins are changed in to glucose. About 60% of proteins is converted in to glucose and 10% of fat into glucose.

Many of the manifestations of diabetes mellitus are due to the unopposed action of the pituitary.

Each gram of carbohydrate supplies 4·1 C Daily requirement. About 500 grammes adults.

Sources.

Cereals, pulses, tubers and other plants.

(2) *Fats.* Fats are triglycerides of oleic, palmitic or stearic acids; butyric acid and other fatty acids Fats perform two functions in the body.

(1) Provides energy,

(2) Provides fatty acids for the manufacture of lipins for nervous and other tissues.

Digestion and metabolism of fat.

Fat Metabolism.

Digestion of fats. Stomach. A fat-splitting enzyme

(*gastric Lipase*) is present in the gastric juice. Pancreatic Lipase may regurgitate in to the stomach from the duodenum.

Small intestine. Pancreatic lipase is the chief active ferment. The activity is hampered by the slightly acid reaction of the intestinal contents. The bile salts increase its activity fourteenfold. Neutral fats are broken down into glycerine and fatty acids.

Absorption of fat. Fatty acids and bile both must be present for the absorption of fat to occur. Bile acids unite with fatty acids to form loose chemical compounds which are water soluble and diffusible. In the intestinal villi this compound breaks up once more into fatty acids and bile acids and bile acids again pass back to the intestinal surface to assist in the transfer of further quantities of fatty acids.

Fatty acid is ultimately reconverted into neutral fat which later appears in the lymph and finally in the blood. Fatty acid first unites with glycerol and inorganic phosphate to form a phosphatide. Intestinal absorption of fatty acid is accelerated by the addition of glycerophosphates.

Fat Metabolism

Blood fat. Fat exists in the blood in various forms:—
(1) Neutral fat. (2) Lecithine. (3) Cholestrol.

The neutral fat from the thoracic duct enters the blood as finely divided particles.

The fat is probably removed from the blood by the liver, the tissues generally and the fat depots.

Sources of Depot Fat are :—

(1) From fat of the food.

(2) From carbohydrate. When carbohydrate is transformed into fat, a substance rich in oxygen is converted into one which is poor in oxygen. Much oxygen is left over in the body and less need be taken up from the atmosphere. The R. Q. rises above one.

Role of Liver. Normally liver contains about 3% of fat. Fatty acids reaching the liver undergo desaturation as a result of removal of hydrogen and fat is changed into lecithine. Lecithine is passed back in to the blood for utilization by the tissues.

Fat of tissues. It is in 2 forms :—

(1) Neutral fat, which is used for energy purposes.

(2) Element cónstant, which can not be reduced in

amount without death resulting. It is intimate part of "protoplasm".

Utilisation of fat. Skeletal muscle can combust directly both carbohydrate and fat and will use varying proportions of these substances under different conditions to provide energy. Fat is first combusted to B-hydroxy-butyric acid and aceto acetic acid. Then to acetone and CO_2 and H_2O. The last complete oxidation proceeds only if sugar is being burnt in adequate amounts at the same time. In diabetes to avoid ketosis the fat content (F) of the diet must not exceed the sum of twice the carbohydrate (c) and half the protein (p). Ketosis occurs whenever a large amount of fat is being metabolised with insufficient glucose. It may happen :—

(1) When the amount of carbohydrate in the diet is in very small quantity or when the amount of fat in the diet is very large and carbohydrates in moderate amounts.

(2) Vomiting is persistent.

(3) In diabetes mellitus the body can not burn carbohydrates.

Vegetable and animal fats. Vegetable fats are as nourishing as the animal fats but they lack vitamin A and D. Ghee and Butter can be easily replaced with vegetable Ghee and artificial butter to which vitamins may be added. Cod liver oil or shark liver oil is easily absorbed. Ghee has very little vitamin A, and people in India lay too much stress on ghee, they do not realise the importance of proteins.

Daily requirement for an adult 70—100 grammes. Cereals can very well replace fat for energy purposes.

CHAPTER VII.

Water

Sixty six percent of total weight of the body is made up of water. Body cells function best when bathed in a fluid of certain optimum composition which is kept constant in health. Body is kept in a state of water balance in health.

The supply of water to the body comes from :—

(1) By drinking (2) From food	1000 c.c. each	more in hot weather

(3) oxidation of fats, carbohydrates and fats 400 c.c.

The loss of water is through the following channels.—

(1) Through the perspiration	450 c.c.	much more in hot weather
(2) Expired air	300 c.c.	
(3) Urine	1,500 c.c.	
(4) Faeces	150 c.c.	

Water reserve of the body. Voluntary muscles are chiefly the site for storing water. Muscles give up a considerable quantity of their water content with out suffering any impairment in function. The volume of water in reserve in muscles is about one twentieth of the total body weight, say a little over half a stone in adult or over one

pound in the infant. When this water reserve is used up, the percentage of water in the blood falls and tissues begin to suffer from lack of water in the fluids which bathe them. Then the signs and symptoms of dehydration appear. This depletion of the water reserve in making good the water lost by the blood by normal or abnormal channels of excretion is the first stage of water deficiency. It is very important to recognize this stage and start measures to combat it. It is accompanied by loss of about one twentieth of the body-weight but not by a dry tongue, loss of elasticity of the skin or by any signs of circulatory failure. After the exhaustion of water reserve the stage of dehydration sets in. The tongue is dry, the skin has lost its elasticity. Later on Hippocratic facies develop and circulatory collapse may set in. The onset of the dehydration may be very sudden and the circulatory collapse may set in very rapidly and therefore it is very important to make an early diagnosis. This is particular the case in the infant, one night of diarrhoea may be enough to make all the difference. The dehydration must be prevented and treated by administring fluid parenterally or via the alimentary route by the help of Ryle's tube if necessary.

The tube has been used successfully in the following cases:— Malaria and Blackwater fever, cerebral malaria,

Cerebrospinal meningitis, Enteric fever and typhus, pneumonia, psychoses and Coma due to other causes.—*e.g.* head injuries.

The tube is quite comfortable in situ. It does not embarrass the respiration. Food, fluids and drugs may be given as necessary independently of the patient's desires. In gross dehydration the requirred fluid quantity may be 10—15 pints which it is impossible to give by the intravenous route. Saline absorbed from the alimentary canal is better retained and produces a less immediate diuresis than does saline given intravenously.

Technique of Passing the Tube.

Cases may be divided in to three groups :—

Group I.—Those with a swallowing reflex even in the presence of coma.

The tube is passed in to the nostril, and gently pushed backwards along the floor of the nasopharynx. Now pass 6—8 inch of the tube, when the patient will cough, wait until retching occurs, followed by a swallow, which will draw the tube into the aesophagus, after this it may be rapidly pushed down to the third mark on the tube. There is no danger of getting the tube into the larynx if the act of swallowing is awaited before passing it onward.

Group 2.—Those without a swallowing reflex—*i.e.* cases in deep coma.

Prop up the patient and lean him forward. Put two fingers in to the mouth and the posterior pharynx, using a mouth-gag if necessary. The tube is passed through the nostril and in to the pharynx, fingers are used to guide it behind the epiglottis into the esophagus. It is pushed onward. A little of the gastric contents is aspirated to see that the tube is in situ.

Group 3.—Refractory patients—*e.g.* maniacal and cerebral irritation cases.

Either of two methods may be used. One is to anaes thetize with an intravenous barbiturate (evipan sodium) just short of abolishing the swallowing reflex. If this is abolished, wait until it returns, when the tube is in the stomach put in a dose of potassium bromide gr 40, chloral hydrate gr 20, with or without tinct-opii mm 20 or paraldehyde drs 2. The alternative method is to produce twilight sleep with intramuscular sodium luminal or subcutaneous scopolamine morphine.

Fixation of the Tube

Bring the free end alongside the nose and up to the

forehead between the eyes, and fix it with strapping. The free end may be tied or closed with a clip. Some patients, especially psychotics, tend to pull out the tube at first. This is prevented by splinting the arms and tying to the bed. Or giving sedatives through the tube. Fluids and feeds may be given either as a continous drip or by means of a funnel.

Dangers

There is the possibility of ulceration of the laryngo-pharynx and danger of bronchopneumonia arising from the aspiration of gastric contents regurgitated alongside the tube. The latter is minimised by drip method. These are minor dangers. The tube must be lubricated well. Best is liquid paraffin but vaseline, olive oil may be used.

G. A. Ransome The British Medical Journal.
November 4, 1944 (594—596)

Excess of water in the tissues will lower the temperature cause vomiting, convulsions and death, but this state rarely arises in a healthy person as kidneys excrete the excess of water. But if water consumption has not been decreased in the treatment of Diabets inspidus with pituitrin this state can arise.

So the real danger is from drinking too little. Water is

not absorbed by the stomach. Taken on an empty stomach it produces diuresis but normal saline has no such effect. Water taken with a meal is not excreted so rapidly.

When water enters the stomach, it begins to pass out into the intestine almost at once. Hot water passes out much more quickly than the cold as the heat stimulates the peristalsis and opens the pylorus. The water is absorbed from the small intestine. If water is contaminated it is a very dangerous carrier of disease as it has no time to be sterilised by the gastric juice. This is more dangerous than contaminated milk which comes in contact with the gastric juice in the stomach.

Water does not delay digestion if taken with meals. It may help digestion by softening the foods. Drinking with meals also facilitates absorption. The function of water is to eliminate the waste products. Free supply of water eliminates the toxins in fevers and harmful products of metabolism in gout and diabetes.

A good drinking water should have no colour, no odour or no taste. It should not contain solids more than 8½ grains per gallon. It should contain very little organic matter of vegetable origin. An excess of chlorides is suspicious of contamination of animal origin.

Water

Contaminated water can spread the following infections:—

(1) Cholera (2) Typhoid (3) Diarrhoea, dysentery
(4) B. Coli infection (5) Guinea worm infection
(6) Hook worm infection (7) Round worm infection.

CHAPTER VIII.

Well-balanced diet and Food Economy

A diet sufficient for normal growth, health and for an energetic life at a reasonably high level of working capacity is called a well-balanced diet. It should contain all the various components of diet in proper proportions. From the study of previous chapters we are now in a position to construct a well-balanced diet. For example for an adult male we require :—

(1) Calories.	2,400—3,000 C. per day. The diet must be sufficient to provide the requisite number of calories.
(2) Proteins.	75 Grammes per day. Half or at least one fifth of this amount (15—37 Gms.) should be of animal origin.
(3) Vitamins.	The diet must provide :—

Vitamin A	5000—7000	units a day
Vitamin D	500	"
Vitamin B_1	300 units or 1 mg.	"
Nicotinic Acid	30—50	" "
Riboflavin	$\frac{1}{2}$—1	" "
Vitamin C	25—50	" "

(4) Minerals. The diet must provide daily :—

1. *Calcium* 0·75—1 gm.
2. *Iron* 15 mg.

The diet must be rich in protective foods. The protective foods include :—

(*a*) The dairy products such as milk, cheese, butter, cream and eggs.

(*b*) Green vegetables and fruits. 110626

(*c*) Sea products as fish.

Out of all these protective foods the most essential article of diet is milk as it supplies first class proteins calcium and phosphorus. The minimum consumption of milk daily per head should be one quart (24 oz.) as recommended by Mccollum. Milk is indispensible during the period of growth, lactation and pregnancy. Milk (or curd, cheese etc.) still remains the cheapest source of first class proteins and separated milk is as rich as whole milk in proteins at a very much lower cost.

Eggs, are rich in first class proteins, vitamins especially D. Phosphorus and iron. One egg daily will protect an infant against rickets.

Stiebeling and Ward recommend the following rules

for well balanced diet :—

(1) At least half the total calories should be taken in the form of fruits, vegetables and milk.

(2) At least half the cereals and bread stuffs consumed be in approximately whole grain forms.

Below are given tables for different economic levels as recommended by them :—

Yearly per capita consumption of Foods at different Economic Levels as Recommended by Stiebeling and Ward.

Food		Adequate diet at Minimum cost	Moderate cost	Liberal cost
Milk Quarts.		260	305	305
Potatoes, sweet potatoes	lbs.	165	165	155
Dried Beans, Peas, Nuts.	,,	30	20	7
Tomatoes, citrus fruits.	,,	50	90	100
Leafy green and yellow vegetables	,,	80	100	135
Dried fruits.	,,	20	25	20
Other fruits and vegetables.	,,	85	210	325

Food	Adequte diet at Minimum cost	Moderate cost	Liberal cost
Cereals.	„ 224	160	100
Fats.	„ 49	52	52
Sugars.	„ 35	60	60
Meats, poultry, fish.	„ 60	100	165
Eggs.	„ 15	15	30

Translated in to the terms of daily consumption, this is as follows :—

Food	Adequate diet at Minimum cost	Moderate cost	Liberal cost.
Milk	17 oz.	20 oz.	20 oz.
Potatoes or Sweet Potatoes	7 „	7 „	6·7 „
Dried beans, Peas nuts	1⅓ „	¾ „	⅓ „
Tomatoes. citrus fruits	2¼ „	4 „	4¾ „
Leafy vegetables	3½ „	4⅓ „	4¾ „
Dried fruits	¾ „	¾ „	¾ „
Other fruits and vegetables	3¾ „	9¼ „	14 „
Cereals	9¾ „	7 „	4⅓ „
Fats	2⅙ „	2⅓ „	2⅓ „
Sugars	1½ „	2¾ „	2¾ „
Meat, fish	2 „	4⅓ „	7 „
Eggs	½ egg	½ egg	1 egg

The differences in these diets are apparent. In adequate diet at minimum cost animal protein, and vitamins and minerals are just sufficient for body requirements, while in other diets they are present in liberal amounts.

These diets, 'however' are not suitable for Indian climate due to high meat content.

Below is given a mixed (non-vegetarian) balanced diet commonly used by certain races of Northern India (Mc Carrison).

Food stuff	Amount in ounces	Proteins Gms.	Fats gms.	Carbohy-drates Gm	Calories
Atta ...	12	46·8	6·48	244·2	1222
Rice ...	6	13·80	0·51	133·8	595
Meat ...	2	12	4		85
Vegetable oil ...	1		28		252
Ghee ...	1·5		34·6		312
Vegetables & fruits	20 ounces	8	1·5	64	300
Dal ...	1	6·5	1	16·2	100
	63·5	105·5	96·42	484·2	3221
Less 10 % for wastage	6·3	10·5	9·64	48·4	322
	57·2	95	86·78	435·8	2900

Well-Balanced Diet.

For a vegetarian a sample of well-balanced diet is given below.

Aykroyd has given the following composition for a "well-balanced" diet :—

Protein	73	gms.
Fat	74	"
Carbohydrate	408	"
Calories	2600	
Calcium	1·02	"
Phosphorus	1·47	"
Iron	44·00	m. gms.

Vitamin A (international units over 7000.

Vitamin B^1 " " " 400.

Vitamin C " about 170·0 mgms.

Translated into the terms of food stuffs, this diet is :—

			ozs.
Raw milled Rice	...	...	10
Millets	...	...	5
Milk ...	...	...	8

Pulses :—

Dal Arhar	1	oz.
Black gram	2	ozs.

Non-leafy vegetables			ozs.
Brinjal	2	ozs	
Ladies-fingers	1	oz.	
Snake gourd	1	,,	
Cluster beans	1	,,	
Drumstick	1	ozs.	6
Leafy vegetables.			
Amaranth leaves	2	ozs.	
Drumstick leaves	1	oz.	
Spinach	1	,,	4
Gingelly oil.			2
Fruits.			
Mangoes	1	,,	
Ripe plantains	1	,,	2

Very good work has been done by the Bombay Presidency Baby and Health week Association in this connection and they have recommended the following diets :—

Balanced Diets

Non-vegetarians.

		At Minimum cost Per man		At Moderate cost Per man	
		per day	per month	per day	per month
			lb. oz		lbs. oz.
1. Rice	Rice broken (Kani)	11 oz.	20—10		
	Bran (Fresh rice polishings)	1 „	1—14	0·75	1—6
	Rice polished	..	...	2 oz.	3—12
	Rice unpolished	...	...	4 „	7—8
2 Other Cereals	Wheat Bajra Jowar	6 „	11—4	11 „	21—4
3. Pulses	Lentils Turdal Peas & Beans	1 „	1—14	2 „	3—12
	Whole Horse Gram	0·8 „	1—8		
4. Soya Beans	...	1 „	1—14	1 „	1—14
5. Vegetable oils	Sweet oil Coconut oil	1 „	1—14	0·50	0—15

		At Minimum cost Per man		At Moderate cost Per man	
		per day	per month	per day	per month
			lbs. oz.		lbs. oz.
6. Animal fats	Tallow etc	1 "	1—14	1 "	1—14
	ghee or butter	...	...	0·50	0—15
7. Skim milk	Dried skim milk	0·5=5 ozs. of skim milk	1—0	0·5=5 ozs. of skim milk	1—0
	Milk	...	...	4 oz.	7—8
8. Oilcake	Ground nut, cake	0·5	0—15	0·50	0—15
9. Flesh food	Meat, fish, eggs	3 "	5—10	3 "	5—10
10. Sugar	Jaggery (gur) sugar	1 "	1—14	1·50	2—13
11. Roots & fruits	Tomato raddish carrot, potatoes	3 "	5—10	6 "	11—4
12. Leafy vegetables	Spinach cabbage etc	6 "	11—4	6 "	11—4
13. Condiments	...	...	a little	...	...
14. Salt	...	...	"	...	...

Balanced diet

Vegetarians

Group	Foodstuffs	At Minimum cost Per man		At Moderate cost Per man	
		Per day	per month	Per day	per month
			lbs. oz.		lbs. oz.
1. Rice	Rice Broken (Kani)	11 oz.	20--10	—	—
	Bran Rice polishings	1 "	1—14	0·75 oz.	1—6
	Rice polished	...	...	4 "	7—8
	Rice unpolished	...	...	6 "	11—4
2. Other cereals	Wheat, Bajra, Jawar	5 "	9—6	8 "	15—0
3. Pulses	Lentils (masoor), Turdal (pigeonpea), Peas and beans	2 "	3—12	1·20 "	2—4
	Whole Horse gram	0·8 "	1—8	0·8 "	1—8
4, Soya beans	...	1·5 "	2—13	1 "	1—14
5. Vegetable oils	Sweet oil, Cocoanut oil	1·2 "	2—4	1 "	1—14

Group	Foodstuffs	At Minimum cost Per man		At Moderate cost Per man	
		Per day	per month	Per day	per month
			lbs. oz.		lbs. oz.
6. Animal fats	Ghee or butter	0·75 „	1—7	0·75 oz.	1—7
7. Skim milk	Dried skim milk	1·5=1·5 ozs of skim milk	2—13	1·5=15 ozs. of skim milk	2—13
8. Milk	...	...	...	5 oz.	9—6
9. Oil cake	Ground nut cake	0·5 oz.	0—15	0·5 „	0—15
10. Sugar	Jaggery (goor) or sugar	1·0 „	1—14	1·50 „	2—13
11. Root & fruit vegetables	Tomato, raddish, carrot, potatoes etc.	3·0 „	5—10	6·0 „	11—4
12. Leafy Vegetable	Spinach cabbage ete.	6·0 „	11—4	6·0 „	11—4
13. Condi-ments	Chillie, ginger, pepper	... small quantity	...	...	...
14. Salt	...	... small quantity	...	...	...

Dietaries of Various Countries 1934—38 (B. Lamartine Yates) In Ounce Daily.

	Germany.	France.	Switzer-land	Denmark.	Great Britian.
	oz.	oz.	oz.	oz.	oz.
Bread and flour	9·8	12 3	8·7	8·6	8·6
Potatoes	17·3	17·4	8·5	11	9
Sugar	2·5	2·5	4·2	5	4·5
Meat	4·3	3·3	4·5	5 3	6·5
Milk	9·6	10	2·8	15	9
Butter	$\frac{2}{3}$	$\frac{3}{5}$	$\frac{4}{5}$	$\frac{5}{8}$	1
Margarine	$\frac{2}{3}$	...	...	2	$\frac{1}{8}$
Cheese	$\frac{3}{5}$	$\frac{3}{5}$	$\frac{4}{5}$	$\frac{3}{8}$	$\frac{2}{8}$
Eggs (No per week)	2·2	2·7	3	1·9	8

Diet of an Indian Soldier in peace time :—

Cereals	24	oz.
Dals	3	,,
Sugar	$1\frac{1}{2}$	,,
Ghee	2	,,

The above may be compared to the peace time ration of the British Soldier in India.

Bread	1	lb.
Flour	¼	"
Meat	1	"
Onions	6	oz.
Potatoes	10	"
Sugar	2½	"
Vegetables	½	lb.

Diet used in Indian Jails

Cereals wheat or Indian Corn	24 oz.	
Pulses	6 "	
Vegetables	6 "	(Pardey, Black & Stewart)

Diets of well-to-do people in various Provinces in India are given below.

I. Bengal

(1) Morning (Bengal).	Boiled rice about 3 chattack or 6 oz. with dal and vegetables.
(2) Midday meat Rice	5 chattack or 12½ oz.
Dal, fish	1½ chattack or 4 oz. or curds 8 oz. Chhana' fresh cheeze 2 oz.
Oil	about ½ chattack or 1 oz.
Vegetables	about 2 chattacks or 4 oz.

(3) Night meal same as midday meal.

Diets of well to do people in various parts in India are given below :—

II. Punjab and U. P.

Early Morning	Wheat (Chapati)	about 2 chhattack or 4 oz.
Milk or	Curds	From ½ seer—3 Pao 16—24 oz.
Mid-day Meal	Wheat (Chapati)	about 5 chhattack or 12 oz.
	Pulses	about ½ chhattack 1 oz.
	Vegetables	5 chhattack or 5 oz.
	Ghee	¼ chhattack or 1½ oz.

Meal at night just as mid-day meal.

Majority of people take two meals one in the morning and one in the evening as described above which is supplemented with 12—24 ozs. (1½—3 Pao) of milk.

Mohammadens take more of meat and eggs which replace some of pulses and milk of vegetarian diets.

III. An average Agriculturist in India takes

Early morning 2—4 oz. (Gur) raw sugar with Chapati of Bajra or Maize or about 1 seer Lassi (diluted curds).

Mid-day.	Flour (Bajra, Juwar, Maize)	3 chhattack or	
		or Wheat	8 oz.
	Pulses	1 chhattack or	2 oz.
	Vegetables	1 chhattack or	2 oz.

Dinner same as mid-day.

An average cultivator in India gets less to eat than a prisoner (W. Burridge).

These Indian dietarics may be compared with some of the foriegn dietaries.

Diets

Class of person	Proteins in Gms.	Fats.	Carbo-hydrates.
Profession man (Mixed diet)			
U. P. or Punjab	117	159	442
" " U. S. A.	110	136	442
Well-to-do people (Bengal)	100	150	400
Mccays' Bengali student	67	71	548
Mccays' Anglo Indian	94	56	467
U. P. Cultivator average	65	19	363
U. P. Prisoner McCay	84	10	348
Bengal " "	52	25	475
U. S. A. Farmer	101	128	476
Average Londoner	98	60	416

The Indian diets have the following defects :—

(1) Proteins are mostly of vegetable origin. Quality of proteins should be improved by the addition of milk or milk products, fish or eggs.

(2) There is excess of carbohydrate.

The diet of rich men and well to do persons in India.

These diets are rich in fats and sugar. People have wrong notions about the importance of ghee to which undue importance is laid in India. Like meat, ghee or excess of fat is also unsuitable to a hot climate. Sugar in excess is also harmful. These diets contain about 24 ozs. of milk which will provide about 24 grammes of animal protein. These diets predispose to obesity and diabetes mellitus.

2. *Diets of females.* The diets of Hindu females is particularly defective. Even among those communities of Hindus who eat meat and eggs, females do not touch them. The only choice for animal protein left is milk or milk products which is not taken. Females generally give good food to their male members and no steps are taken to improve the diet during pregnancy and lactation. During puerperium milk is not given, but preparations containing

sugar and carbohydrates. The diet lacks in animal proteins and calcium and vit. D. A female must have at least a seer of milk during pregnancy and lactation.

3. Diet of children. Children require plenty of animal protein, vitamin D. and calcium.

Every child needs at least 3 *pao* of milk daily up to the age of 13 and 1 seer between 13—16 years. Every child may be given at least one egg daily over and above it.

Suggestions to improve Indian Dietaries.

(1) As regards protein :—

1. From animal sources. Use of milk or milk products should be increased. Fresh cheese prepared from curds after removing its water should be used more extensively. Mawa or Khowa should be used more and more. Separated milk is as valuable for its proteins as whole milk. Lassi from which butter has been removed is equally valuable. Skim milk, dried skim milk should be used.

2. *Eggs.*— Eggs should be given to children and females during pregnancy and lactation.

3. *Fish.*—Fish is valuable for proteins and vitamin D.

(2) Vegetable sources.

1. Consumption of pulses should be increased especially with rice. Soya bean should be cultivated and should be available more and more.
2. Use of ground nuts, raw or roasted should be increased. There is a prejudice amongst the masses that they are heat giving. Ground nut cake may be used.

II. As regards vitamins :—

For vitamin D, synthetic preparations and fish oils should be used. Fish and eggs should be used.

For vitamin A, vegetable sources containing carotene are quite good Tomatoes and Carrots and Mangoes are very valuable in this respect.

For vitamin B, bran of rice and wheat should be utilised, raw ground nuts are valuable source of vitamins. They may be soaked over night. Yeast should be used.

For vitamin C, oranges, lime, lemon, rose hips, tomatoes. *A mla* (Indian gooseberry) are rich sources. One

guava, *Amla* green or dried is enough for an adult but the disadvantage is due to the content of tannic acid. Cabbage, mint, coriander, radish should also be used.

Rose hips are wasted in our country. Rose hips are very rich in vitamin C. Germinating seeds are very cheap.

III. Carbohydrates.— Sugar is a luxury. Rice and maize should be replaced by other cereals; the use of potatoes and sweet potatoes and bannanas is a good supplement for vitamins and cereals.

IV. Fats.—Vegetable fats may easily replace *ghee*. Vegetable *ghee* and oils are equally valuable. *Ghee* is not rich enough in vitamins. Content of vitamin A is insufficient which is better supplied by carotenes in vegetables. Content of vitamin D is almost negligible.

V. Minerals.—Calcium deficiency is common in women and children. The best way is to increase consumption of milk and milk products. Calcium salts may be added to bread. Leafy vegetables may be used.

For iron deficiency in females it is much better to use iron salts.

Economy in Food.

It is the duty of the dietetician to give suggestions for

optimal dietary at lowest cost. In order to study the question of food economics the food stuffs may be classified according to their nutritional characteristics as follows:-

(1) Cereals.—Economical source of energy and protein but not satisfactory in their mineral and vitamin content.

(2) Sugars and fats.—Sources of energy.

(3) Meats, fish and poultry.—Rich in protein or fat or both but showing, in general the same mineral and vitamin deficiencies as do the cereals.

(4) Fruits and vegetables—sources of minerals and vitamins.

(5) Milk and casein products.—Source of energy, protein, minerals and vitamins; the most efficient of all foods in making good the deficiencies of cereals and in ensuring the all round adequacy of the diet.

(6) Eggs.—Intermediate between meat and milk, rich in protein, iron and phosphorus and vitamins but not capable like milk of promoting the development of wholesome bacterial flora in the digestive tract. In our country the most prominent characteristic of diets is the predominence of cereals. In European and American

countries especially in the U. S. A. meat is very prominent. A typical American food budget distributes its expenditure in round numbers about as follows:—

(Sherman)

Meats, Poultry and fiish	...	25—40%
Eggs	...	5%
Milk, Cream and Cheese	...	10%
Butter and fats	...	10%
Bread and Cereals	...	15—20%
Sugar	...	5%
Vegetables and fruits	...	15%
Food adjuncts	...	5%

This above diet gave the following average food value per man per day.

Calories		...	3256
Proteins,	grammes	...	106
Phosphorus	„	...	1·63
Calcium	„	...	·74
Iron	„	...	·018

American diet is defective in Calcium and also in vitamin B_1.

In England enrichment of bread with calcium carbonate to increase its calcium content has been tried. In U. S. A. by the order of the War Food Administration all baker's white bread, white rolls and sweet rolls must be enriched with vitamins of the B complex and iron to the stated levels in order to bring them to the levels of these constituents found in similar products made from whole wheat flour. The value required for riboflavin slightly exceeds that of whole wheat preparations. Before the advent of the enriched flour the average American dietary showed the thiamine content to be 0·8 mg, riboflavin 1·4 mg. and niacin 11 mg. per 2500 Calories whereas the National Research Council's recommended daily allowance for thiamine is 1·6 mg., riboflavin 2·2 mg. and niacin 15 mg. for caloric intake of 2500.

The addition of thiamine, riboflavin, niacin and iron to white flour and bread serves to replace what has been lost in the milling process. It does not change the appearance and taste of food. This has resulted in marked decrease in cases of florid beri beri and florid pellagra and great benefit to those suffering from mild chronic degrees of deficiency states.

Sherman made an extensive study of American diets in order to find out the relative cost and merits of different

diets predominating in one or the other food stuffs. Diets rich in cereals are the cheapest but are also low in calcium and vitamin contents, as shown below:—

200 American dietaries arranged into 3 groups according to the relative prominence of grain products in the food budget (Sherman).

Expenditure in each type of food in percentage of the whole.

Types of Food	"Low grain" Diets	"Medium grain" Diets	"High grain" Diets
Grain products	10·8	17·6	27·7
Meat and Fish	34·8	34·6	30·7
Eggs	7·2	6·0	3·9
Milk and Cheese	12·7	11·5	9·1
Butter and Fats	11·1	9·0	9·7
Sugars	4·8	4·6	4·8
Vegetables	10·8	10·9	11·1
Fruits	7·8	5·8	3·1

This is translated in the terms of costs and food values as follows (Sherman):—

	"Low grain" Diets	"Medium grain" Diets	"High grain" Diets
Relative cost	120	108	76

	"Low grain" Diets	"Medium grain" Diets	"High grain" Diets
Calories per head per day	3442	3163	3189
Proteins	113	107	99
Phosphorous	1·80	1·65	1·45
Calcium	0·88	0·76	0·60
Iron	0·0204	0·0177	0·0157

The defect of high cereal diet is best corrected by the addition of milk and vegetables to the diet. The effect of predominence of milk in diet is given below :—

224 American dietaries studied according to the quantity of milk (Sherman).

Expenditure for each type of food in percentage of total expenditure.

Type of Food	"Low milk" Diets	"Medium milk" Diets	"High milk" Diets
Milk and Cheese	4·7	10·7	20·0
Meat and fish	35·1	34·5	28·4
Eggs	5·6	5·8	5·5
Butter and fats	10·4	9·5	10·1
Grains	22·4	17·8	16·9
Sugars	4·8	4·7	4·5
Vegetables	12·0	10·7	10·2
Fruits	5·8	6·3	4·5

This is translated in total costs and food values as follows (Sherman):—

	"Low milk" Diets	"Medium milk" Diets	"High milk" Diets
Relative cost	84	108	100
Calories	3271	3130	3516
Proteins	103	106	112
Phosphorus	1·45	1·56	1·96
Calcium	0·51	0·74	1·06
Iron	0·0178	0·0176	0·0186

So diets rich in milk are strikingly rich in calcium. So milk is the greatest factor to ensure a satisfactory supply of calcium in the diet, much more than any other food stuff.

Meats, poultry and fish.—Relation of the prominence of meat in the dietary to the distribution of cost and to food value is shown below:—

A. Expenditure for each type of food in % of the whole.

Type of food.	Percentage of Total Expenditure in "Low-meat diet"	"Medium meat diet"	"High meat diet"
Meats and fish ...	18·4	34·3	46·2
Eggs ...	5·9	5·9	4·6

Type of food.	Percentage of Total Expenditure in "Low-meat diet"	"Medium meat diet"	"High meat diet"
Milk & Cheese ...	11·7	11·6	3·5
Butter & fats	13·6	9·5	7·2
Grain products ...	21·6	18·5	17·5
Sugar ...	5·6	4·7	3·9
Vegetables ...	14·0	10·6	8·8
Fruits ...	9·3	4·9	3·3

B. Comparison of Total costs and of food value.

Relative Cost ...	100	100	96
Calories ...	3821	32·2	2822
Protein ...	103	108	107
Phosphorus ...	1·75	1·63	1·48
Calcium ...	0·89	0·76	0·55
Iron	0·0182	0·0181	0·0170

The "high meat" diets as compared with the "low meat" diets show marked decrease in calories and calcuim, considerable decrease in phosphorus, and significant change in either protein or iron. These diets are poorer in vitamins. The meat often advocated as a food on the ground of its relatively high protein and iron contents, does not make the dietary richer in protein and iron as the meat becomes more prominent in the food

budget as the meat is costly. So that while the concentration of protein and iron in meat is relatively high, the amount of protein and iron obtained for a given amount of money are no higher in meat than in the average of other food, while the amount of other nutrients are much lower.

Study of these dietary data suggests the desirability of a shifting of emphasis from meat to milk in the food budget. When people of average income spend as much as a third of their food money for meat, there arises a serious question whether the food will then provide for sufficient amounts of milk, butter, vegetables, and fruit to support the best condition of nutrition and the highest degree of health.

Food Administration of New York studied the data collected by the New York Association for improving the condition of the poor and made the following suggestion :—

Divide your food money into fifths :—

One-fifth more or less for vegetables and fruit.
,, or more for milk and cheese.
,, or less for meats, fish and eggs.
,, one-fifth or more for bread and cereals.
,, or less for fats, sugar etc.

(Sherman)

Sherman recommends :—

(1) at least as much should be spent for milk as for meats, poultry and fish.

(2) at least as much should be spent for fruits and vegetables as for meats, poultry and fish.

Lusk pronounced the dictum "the housewife having a family of five to feed should buy three qrts. of milk a day before she buys a pound of meat".

First set aside the money for a constant milk supply sufficient to provide a qrt. of milk a day for every child and at least a pint for every adult; then divide the rest of the food money into three approximately equal parts, one for fruits and vegetables, one for bread stuffs and cereals, butter and other fats and one for meats, eggs, sweets and miscellaneous.

To sum up, the dietary should be built round bread and milk and vegetables.

(1) Cereals.—The different cereals used in our country are :—Wheat, rice, barley, maize, millets. Rice has become the poorest cereal because it is subjected to polishing and refining processes. Whole grains are ideal from nutritive point of view. Maize, *juwar*, *bajra* are very similar to

wheat in dietary properties and it has become a question of taste and cost to choose one cereal or the other. Barley is equally good but the chief defect is the difficulty in getting rid of the husk. Rice polishings should be used with any diet of cereals especially with the rice.

(2) Sugars and fats.—These foodstuffs are sources of energy. Sugar has come to play a very prominent role in the modern civilised dietary.

Such an extensive use of sugar is not desirable.

The use of sugar should be cut down and refined sugar should be replaced by brown sugar or crude sugar to a great extent. Vegetable fats may well replace animal fats. Animal fats contain vitamins A and D. Vitamin A can be easily supplied by vegetables in the form of carotene. With the exception of fish liver oils, animal fats are poor sources of vitamin D. Vitaminised vegetable fats can be used with advantage in place of butter. Cereals can very well replace fat to a very great extent.

(3) Meat, fish and poultry. They are costly and their use is not indispensible in human diet. In a tropical climate their use is not desirable. From economic point of view, there is nothing in favour of meat in any climate.

The protein and energy values of the total meat yielded by an animal represents at most about $\frac{1}{10}$ of the total protein and energy values of the food which the animal has consumed, for only a fraction of the nutrient of the food is converted into and retained as body material by the animal and scarcely half the total body weight of the animal is utilised as food for man. So meat will be a much more costly food than, for instance, the grain which if not fed to the animal might have been utilised directly as human food. Had the grain been used directly as human food probably $\frac{8}{10}$ of it would have been digested and utilised. Had it been fed to dairy cattle the average return in protein and energy values would average about 3-4 times as much as is obtained from animals fed for slaughter. High meat diets have proved costly and actually poorer in food values. Increasing prominence of meat meant diminishing return in calories and calcium without any compensating increase in the returns in protein, phosphorus and iron. Nuts may replace meat. Pulses, ground nuts and soya bean can well replace meat. Ground nut cake is very cheap and is a good source of protein.

(4) Fruits and vegetables.—Green vegetables should be used in sufficient quantity with a diet of bread and milk vegetables are good sources of minerals and vitamins.

Fruits are costly and return in terms of minerals and vitamins from fruits as compared to vegetables is much less for equal amount of money.

(5) Milk and casein products.—Use of milk is indispensible in human dietary at all ages. Separated milk, butter milk can well replace whole milk from nutritive point of view and at half the cost. Cheese is also cheap, especially prepared from separated milk. In villages *lassi* or *chhachh* can well replace milk. Powdered or fresh skim milk are quite cheap.

(6) Eggs are the most costly form of food stuff. Their use should be reserved for children, women and persons suffering from wasting diseases.

Construction of Dietaries

In constructing dietaries for families and institutions the number of adult males, females and children should be noted. An adult male is taken to be the standard for the purposes of caloric and other requirements. An adult male is said to have a "co-efficient" of 1·0 and his daily caloric requirements in a tropical climate like that of ours is calculated to be 2600 calories (Akyroyd). Changes should be made in the caloric requirements of an adult under the following circumstances:—

Construction of Dietaries

(1) Cold climate or cold weather. Approximately 10% or more calories are added to those of an average requirement.

(2) Amount of work caloric requirements increase proportionate to the physical work done.

Light work. From 75—150 calories per hour of work should be added for the extra light work done by an average adult. Hard Work. From 150—300 calories per hour of extra hard work should be added. Very hard work. From 300 calories or upwards per hour of work should be added.

(3) Brain worker. The caloric requirements are those of an average adult male or probably less.

(4) Age.—Old persons require slightly less food about 10% less or so.

Constituents of Diet.

(1) Protein.—An average adult male needs 75 grammes of protein per day, out of which 15 or 37 grammes should come from animal sources (milk, fish or meat).

This is roughly 1 gramme of protein per kilogram (22 lbs.) of body weight daily.

In tropical climate lesser amount of protein may suffice and the best source of animal protein is milk. Meat proteins have high specific dynamic action and provoke a production of heat of no avail for muscular energy. Moreover meat undergoes putrifaction very rapidly in hot climate.

In hot climate plenty of water is required to be taken in order to compensate for the loss of fluid in perspiration. Water may be taken with meals. Formerly it used to be taught that meals should be as dry as possible and water should be taken about two hours after meals as it was thought that fluids with meals retard digestion by diluting the gastric juice. This is found to be wrong. If necessity of water it felt during meals it should be taken; it helps digestion. Water on empty stomach passes out of the stomach very quickly and does not quench thirst. It is not subjected to the sterilising action of gastric juice as it does not stay in stomach for long and so contaminated water on empty stomach is more likely to cause water borne disease.

Minerals.—Adequate supply of sodium chloride is essential in hot weather. Loss of sodium chloride causes heat cramps. This is prevented by using normal saline as drink instead of pure water. The practice of taking salted

lemon juice (*Nimu-ki-Shikanj-been* and salt) in our climate during hot weather is much to recommend scientifically.

In cold climate higher amount of protein especially of meat is of advantage. The high specific dynamic action of meat keeps the body warm.

A manual worker or athlete does not require increased quota of protein as the increased muscular activity is negligible.

A brain worker needs lesser amount of food and the cut should be made in fats and carbohydrates rather than in proteins and a larger share of proteins should be of animal origin as the animal proteins are compact and easily digestible. Food should be easily digestible and given frequently in small quantities proteins should not be separated from carbohydrates. Proteins taken alone are burnt as fuel in the body like carbohydrates and fats and so become useless for their function of replacing wear and tear.

(2) *Fats and carbohydrates :—*

In tropical climate excessive fat is harmful and carbohydrates may replace a major portion of fats. In cold climate high fat diet is better.

For a manual worker increase in carbohydrate is necessary to meet the increased demands of energy. In cold weather or cold climate it is better to increase fat in diet for a manual worker or an athlete.

(3) *Vitamins.*—Increased amounts of vitamin B, and C are needed for manual workers and atheletes. On an average 10—12 ounces daily of Vegetables are required.

(4) *Minerals.* (1) Calcium: An adult male should get at least ·75—1 gramme of calcium daily and the best article of diet is milk. An adult should take at least 20 ounces of milk daily.

Iron: 15 mgs. of iron daily must come from an ordinary "well balanced" diet.

Females.

An average female requires lesser amount of food than an average male. Her 'Coefficient' of energy requirements is 0·8 as compared to that of an adult male taken to be 1·0. This is about 2100 calories per day.

An average femals needs more iron in her food than male as considerable iron is lost in menstruation every month.

Females.

During Pregnancy and Lactation the caloric requirements of female are increased to roughly 2400C and 3000 Calories respectively. The diet should be rich in first class proteins, calcium, iron and vitamins. Protein 90 grammes, calcium 1·5 grams, phosphorus 2 grammes, iron 20 mgm. daily are recommended (McCauce).

Children. The calorie requirements of children at different ages is given below :—

	Coefficient	Calories required
Age 4—5 years	0·4	1,000
6—7 years	0·5	1,300
8—9 years	0·6	1,600
10—11 years	0·7	1,800
12—13 years	0·8	2,100

Children's diet should be rich in proteins, calcuim, phosphorus and vitamins.

For calculating the food requirement for a family or institution first of all caloric requirements are calculated. Suppose a family consists of four members :—husband, wife and two children of the ages 4 and 7 respectively. The caloric requirements is expressed in terms of 'Coefficients' as follows :—

Husband	Coefficient 1	Calories 2400
Wife	„ 0·8	„ 2100

Child 4 years	Coefficient	0·4	Calories	1,000
Child 7 years	„	0·5	„	1,300
		Total 2·7	„	6,800

This is translated in edible food by increasing 10% more which comes to 7500 calories. Again in purchasing the actual kinds of food stuffs allowance has to be made for non-edible portions consisting of skin, seeds etc. in case of fruits and vegetables and bones etc. in the case of meat.

First of all adequate amount of milk is purchased for the family at the rate of 24 oz. a day for every child and 20 ounces a day for adults.

After milk fruits and Vegetables are purchased. 8—12 ounces a day for an adult and 4—6 ounces a day per head for childern are the rough estimates.

For children, allowance for eggs, should be made if there is no objection to them on religious or economic grounds.

Rest of the diet is made up with cereal products.

Emphasis on meat is unnecessary. The whole day's caloric requirement is divide into three meals in the case

of adults and five meals in the case of children. In our country usually three meals are taken daily. The question of optimum number of meals which will give the maximum efficency and sense of comfort now arises. Experiments have been conducted by Greenby and Haggard to solve this problem and it was found that five meals a day give the maximum efficiency and sense of well being. The food is divided into 3 large meals and 2 smaller meals in between. Some people put a great sanctity on one meal a day especially among the religious persons. Such a practice is harmful. The stomach and digestive organs are loaded too much at one meal and the body is starved for sometime just before the next meal.

CHAPTER IX.

Physiology of Digestive system.

Chemical aspect of Digestion.

(1) *Saliva.*—Saliva in man has a specific gravity of 1,002—1006 and contains about 0·5% of solids. Its reaction varies from p 5·8—7·6. The Solid constituents are :—

(1) Mucin	(2) Ptyalin and
(3) Salts	(4) Bacteria.

Functions of Saliva. They are :—

(1) *Mechanical.*—It moistens the mucous membrane of the mouth; this facilitates speech; the mucin lubricates the bolus of food to facilitate swallowing. It helps to dilute irritants and to cool excessively hot foods.

(2) *Chemical.*—This is due to ptyalin or the diastatic enzyme. It splits cooked starch in to dextrin and maltose; the dextrin is subsequently converted in to maltose also.

It changes glycogen in a similar way but more slowly. It has no action on cellulose.

Ptyalin acts best at about the body temperature. It acts best in a neutral or slightly acid medium, and in the

presence of small amounts of salts. The digestive action of saliva takes place mainly in the stomach. Bacteria are excreted in the saliva and may lead to infection.

Innervation of Salivary Glands.

(1) *Submaxillary gland.*—It has a double nerve-supply :— (1) Parasympathetic (2) Sympathetic,

(1) *Parasympathetic.*—The chorda tympani, a branch of facial nerve. Its stimulation causes secretion of saliva and dilatation of the arterioles.

(2) Sympathetic branches are derived from the plexus around the facial artery, the cell station being in the superior cervical ganglion. Stimulation of sympathetic produces histological changes in the gland and constriction of the arteries.

(2) The Sublingual gland.

This is innervated by the same nerves as the submaxillary.

(3) The Parotid gland.

This also receives two sets of nerve-fibres analogus to the other two glands. Parasympathetic is represented by the auriculo temporal branch of glosso-pharyngeal nerve.

Mechanism of Salivary Secretion.—Ordinarily the secretion of saliva is a reflex action. The principal afferent

nerves are those of taste. Smell or sight of food or irritation of the stomach has a similar effect. The impulses pass to a centre in the medulla from which efferent secretory impulses pass along the parasympathetic.

Aesophago—Salivary Reflex. Irritation of aesophagus causes an abundant flow of saliva. Any bolus held up in the aesophagus is thus washed on.

Gastro Salivary Reflex. Irritation of the stomach also causes an abundant secretion of saliva.

Digestion in the Stomach.

Gastric Juice

Amount of gastric juice excreted daily is from 2,000—3,000 c.c. Composition: —

Water	99·44%
Pepsin	0·32%
Hcl, Free	0·02—0·2%
Inorganic chlorides	0·03—0·3%

Phases of Gastric Secretion :—

(1) *Nervous phase.*—Appetite juice. The sight, smell, or taste of food reflexly produces a flow of gastric juice called appetite juice. Gastric secretion may be inhibited

by anger or fear. Appetite juice is not essential to health. It is of value in initiating the digestion of the food.

(2) *Chemical phase.*—The presence of the food about half an hour after its entery in to the stomach causes a further secretion of gastric juice. This secretion is due to a hormone liberated by the pyloric mucosa, gastrin which passes in to the portal circulation and then reaches the gastric glands through the systemic circulation.

(3) *Intestinal Phase.*—Passing of certain food stuffs (Proteins) in to the duodenum causes secretion of gastric juice. Fat has a retarding effect.

Influence of Diet and Drugs on Gastric Secretion.

(1) Hydrolysed proteins and peptones and meat extracts have a strong stimulating effect.

(2) Dextrin has the same effect.

(3) Glucose inhibits gastric secretion.

(4) Fats act both as inhibitory as well as stimulant.

(5) Alkalis such as sodium bicarbonate except in large doses cause a secretion of gastric juice.

(6) Acids like acetic bring about a cessation of acid secretion. Hydrochloric acid or fatty acids induce gastric secretion.

(7) Tea, Coffee and Cocoa may also act as gastric stimulant.

(8) Condiments reflexly stimulate gastric secretion through smell and taste.

(9) Vegetable bitters probably do not stimulate gastric secretion much.

(10) Water also acts as stimulant to a small extent.

(11) Injection of histamine causes secretion of a juice rich in hydrochloric acid and chlorides but poor in pepsin and mucin.

(12) Atropine by paralysing the vagus reduces gastric secretion. The stimulation of vagus causes secretion of juice rich in pepsin, is strongly acid and contains mucin.

Actions of Gastric juice

(1) Antiseptic.

(2) Proteolytic. Proteins are changed in to peptones.

(3) Curdles milk due to the presence of renin.

(4) Inverts cane sugar in to glucose and fructose.

(5) Lipase splitts fat. A small amount is present.

(6) Hoemopoietic intrinsic factor. Its absence leads to pernicious anaemia.

(7) Protective.—Mucus protects the lining of the stomach against auto-digestion.

Pancreatic juice

Quantity. About 500—800 c.c. are secreted in 24 hours. It is alkaline due to phosphates and bicarbonates.

Composition :—	Water	97·6%
	Organic Solids	1·8%
	Inorganic Salts	0·6%

Enzymes.—Trypsin, Amylase Lipase, A milk-curdling ferment.

Functions.—(1) Trypsin.—It is a powerful proteolytic ferment. It acts best in an alkaline medium. It breaks down proteins to polypeptides and even into amino acids. Fresh trypsin or trypsinagen in the pancreatic duct is inactive. It is activated by the succus entericus.

(2) *Amylase.*—All forms of starch even the unboiled starch are rapidly changed into maltose.

(3) *Lipase.*—It splits fats to glycerine and fatty acids.

(4) *Milk* Curdling Enzyme.

The Mechanism of Pancreatic Secretion.

(1) *Nervous phase.*—Reflex secretion occurs within in few minutes after taking food in the mouth.

(2) Chemical Phase.—The hormone, Secretin, is present in the mucous membrane of the small intestine and reaches the pancreas through circulation. Enterance of gastric contents into the duodenum or introduction of acid into the duodenum or the upper jejunum and still more the introduction of bile excite a flow of pancreatic juice. Bile salts help the absorption of secretin and so excite pancreatic secretion. The juice is rich in alkalie and poor in enzymes.

Influence of Diet on Pancreatic Secretion

(1) Meat causes a large volume of juice rich in alkalie and poor in enzymes.

(2) Fat excites moderate flow with low alkali and high enzyme concentration.

(3) Bread an intermediate flow. Vagus is the secretary nerve and to a less extent is the sympathetic. Vagus controls formation of the enzymes. Secretin cause a flow rich in alkali.

The Succus Entericus.

It is an alkaline fluid containing the following ferments :—

(1) Erepsin converts peptones and polypeptides into amino acids.

(2) Invertase converts cane sugar into glucose and fructose.

(3) Maltase converts maltose into glucose.

(4) Lactase converts lactose into glucose and galactose.

(5) Enterokinase activates trypsinogen.

(6) Lipase acts on fats.

Mechanism of Secretion of the intestinal juice.

Presence of the intestinal contents act as mechanical and chemical stimulant.

Bile helps pancreatic juice in in all its function.

Bile

Quantity. 500—1,000 c.c. is excreted daily.

Composition. It is an alkaline fluid and contains.

(*i*) Bile salts,
(*ii*) Bile pigments,
(*iii*) Cholestrol and Lecithine,
(*iv*) Mucin.

The Bile salts.—These are sodium salts of complex amino-acids called glycocholic acid and taurocholic acid,

High protein diet or administration of cholic acid increases the excretion of bile salts.

Fasting and eating of carbohydrates lowers it. Bile salts facilitate the digestive action of all the pancreatic enzymes-lipase, amylase and trypsin. They aid absorption of fatty acids; Vitamin-D and Vitamin-K, of iron and of secretin. The bile salts are reabsorbed from the intestine, are carried back to the liver, and are then re-excreted in the bile.

Bile pigment-.—Bilirubin and biliverdin are iron-free derivatives of haemoglobin. Bilirubin is formed in the reticulo-endo-thelial system. Biliverdin is formed in the bile passages as an oxidation product of bilirubin.

Cholestrol. The cholestrol of the bile may be an excretion from the blood. A lipoid free diet may be associated with a low bile cholestrol. The blood cholestrol is said to be low in all forms of chronic anaemia. In nephrosis with extensive oedema the blood cholestrol is raised. In chronic obstructive jaundice there is high blood cholestrol as the constituents of the bile are passed back into the blood.

The Secretion of bile.—Bile is secreted continously day and night. The secretion is excited by secretin and

stimulation of the vagus nerve. Absorption of bile or bile acids especially taurocholic acid is a very powerful stimulant for the secretion of bile. Bile is secreted at low pressure so that slight pressure can obstruct its flow.

Gall bladder.

In man gall bladder can hold about 50 c.c. of bile. Bile in it is about 6-10 times as concentrated as the bile in the hepatic ducts.

During a fasting period the sphincter of Oddi lying at the lower end of the common bile duct contracts so that it can resist a pressure of about 300 m.m. bile. Bile is secreted continuously and when the pressure in bile ducts rises to about 70 m.m., bile begins to collect into the gall bladder. During the periods of digestion the sphincter of Oddi partially relaxes and the gall bladder also contracts.

Movements of the Gall-Bladder.—Normally gall bladder shows slow, small, irregular contractions. Stimulation of sympathetic or injection of adrenaline produces a powerful contraction of the gall bladder. Vagus has no effect.

Effect of food.—Presence of large amount of fat in the small intestine is a very strong stimulant to contraction of gall bladder.

Protein is weaker in this respect.

Most purgatives, calomel and magnesium sulphate stimulate the bile-expelling mechanism.

Functions of the liver.

(1) Carbohydrate metabolism.
(2) Protein metabolism.
(3) Fat metabolism.
(4) Bile secretion.
(5) Formation and destruction of red cells.
(6) Antitoxic and protective function.
(7) Coagulation of blood.
(8) Formation of fibrinogen.
(9) Formation of haemoglobin.
(10) Antianaemic.

(1) Carbohydrate metabolism. Liver is a

(i) storehouse of glycogen (ii) It also elaborates sugar from protein and possibly also from fats. (iii) It Changes fructose and galactose into glucose. (iv) It deposits glycogen from the glucose by the help of enzyme glycogenase; insulin greatly accelerates this reaction. (v) If hypoglycaemia threatens, glycogen is converted into glucose.

Functions of the liver.

(2) Protein metabolism.

(1) Formation of Urea.

(2) Deamination of amino-acids. Ammonia is liberated which is again converted in the liver into urea.

(3) Fat metabolism. Liver changes the fat into lecithine which is sent to the tissues. Fatty acids are desaturated.

(4) Bile secretion already described.

(5) Formation and destruction of red cells.

From the middle of foetal life to about 1 month before birth liver and spleen are important sites of blood formation. In times of emergency these organs may take up this function again in post-natal life. It may store red cells too. The Kupper cells of the liver destroy red blood cells and change haemoglobin into bilirubin. This function is common to liver with other constituents of the reticulo-endothelial system. Liver also secretes bilirubin from the blood into the bile capillaries.

(6) Antitoxic and protective function. The Liver excretes certain poisons into the bile *e.g.* heavy metals and toxins.

(7) Coagulation of blood.

The liver is the principal site of formation of fibrinogen.

(8) Liver is also one of the places of manufacture of anticoagulant—the heparin.

(9) Formation of Haemoglobin. Certain constituents of the bile facilitate the absorption of iron and other substances needed for haemoglobin formation and possibly conversion of iron into haemoglobin.

(10) Antianaemic.—The Haematinic principal is absorbed and stored mainly in the liver.

The Mechanical aspect of Digestion.

(1) *Mastication.*—Is a very important process in man. If food is not chewed pr operly dyspepsia may result. Loss of teeth is an important cause of dyspepsia.

(2) *Deglutition.*—The act of swallowing may be divided into three acts:—

(i) The first act is voluntary. Food is forced back to the entrance of the pharynx. The other two are involuntary.

(2) Food gets past the posterior orifice of the nose and the upper opening of the larynx without entering them. This mechanism is stimulated reflexly from the stimulation by the food in the

phaiynx. This reflex may be abolished by spraying the back of the throat with a local anaesthetic.

(3) In the last peristaltic contraction of the aeso-phagus occurs cardiac sphincter relaxes.

Nervous Mechanism.

Sensory:—

(1) Branches of the trigeminal nerves.
(2) Glosso-pharyngeal.
(3) Superior laryngeal branch of the vagus.

Motor:—

(1) Branches of the trigeminal
(2) Bulbar part of the accessory.
(3) The glosso-pharyngeal and vagus.
(4) the hypoglossal.

The centre of deglutition is situated in the medulla oblongata.

Stimulation of the vagus gives rise to peristalsis of the aesophagus, the cardiac sphincter is relaxed. Stimulation of the sympathetic causes contraction of the sphincter only.

Movements of the Stomach.

The stomach has a certain amount of tone. When

empty its walls are in contact with each other. The entrance of food enlarges the cavity uniformly. Peristalsis begins in the upper part of the body of the stomach and pass towards the pylorous which is tonically contracted at this stage.

Some 5—15 minutes after the taking of food the pyloric sphincter relaxes from time to time to allow a small quantity of gastric eontents to escape into the duodenum. The mechanism of pyloric control is not understood. It may open when the gastric contents are either acid or alkaline.

The fasting stomach besides rhythmic variations in tone also exhibits some powerful contractions which give rise to sensation of hunger. Stimulation of vagus sometimes produces contraction and relaxation at other time. It may cause contraction of one part of the stomach and relaxation of another.

Vomiting.

The vomiting centre is situated close to the respiratory centre but is quite distinct. Afferent impulses to produce vomiting may arise in the stomach or intestines, uterus, heart and other organs. The centre itself may be stimulated by toxins and increased intra cranial pressure. The

principal afferent nerves are the trigeminal, glossopharngeal and the vagus. The efferent impulses are carried by the vagi to the stomach, by the phrenics to the diaphragm, and by various other spinal nerves to the abdominal muscles.

Movements of the Small Intestine.

Duodenal cap. The first part of the duodenum when containing food casts a shadow and is known as duodenal cap. There is no peristalsis in this segment. But it contracts now and then to push the food in to the second part of the duodenum. In the distal part of the small intestine beyond the area of duodenal cap there are very active intestinal movements. These are divided into:—

(1) *Peristalsis.*—This pushes the chyme along the small intestine. The movements are frequent and fairly rapid.

(2) *Segmentation.*—A small length of intestine becomes divided into a number of smaller segments. This movement helps to mix the chyme with the intestinal juices and brings it into intimate contact with the villi. It also pumps the blood to heart.

The vagus increases the tone of the intestine and renders the movements more active; sympathetic has the reverse action.

It takes 3½ hours for the food to reach the terminal ileum. Ileo-caecal sphincter. With each peristaltic wave the lower end of the ileum, the sphincter, relaxes and allows a small quantity of fluid faeces to enter caecum. *The sphincter closes again. In human beings, this sphincter delays the passage of the contents of the ileum into caecum* to permit more complete digestion and absorption of the intestinal contents. When food enters the stomach, active peristalsis occurs in the terminal ileum and the chyme rapidly passes into the caecum (gastro-ileal reflex).

Movements of the Large Intestine.

In the terminal ileum chyme is held up for about 1 hour. The food residue reaches caecum after 4½ hours; hepatic flexure 6 hours; Splenic-flexure, 9 hours descending colon, 11 hours, iliac colon, 12 hours; pelvic colon, 18 hours.

The caecum and ascending colon. These parts are said to play only a passive role but there may be weak peristaltic movements.

Gastrocolic reflex.—After each meal a brief, powerful peristalsis occurs in the colon to drive the faeces onwards into pelvic colon where they accumulate. Rectum becomes filled only just before defaecation.

Defaecation.

Most of the water of fluid chyme is absorbed in the caecum and ascending colon. In transverse and descending colon the absorption of water is little. In pelvic colon water is absorbed further and faeces take up normal consistency.

Defaecation.

The centre of defaecation lies in the lumbo-sacral region of the spinal cord. Afferent impulses from the rectum due to the presence of faeces pass to the centre from which efferent impulses pass to the :—

(1) Colon which is strongly stimulated.
(2) Abdominal muscles which are contracted.
(3) Anal sphincter and the levator ani which are relaxed.

Thus the part of the bowel between the middle of the transverse colon and the anus is emptied.

The sympathetic inhibits the whole of the large intestine and closes the sphincter ani. The parasympathetic innervation is uncertain, but its action is motor and relax the sphincter ani.

Functions of the large intestine.—The large intestine secretes mucus which facilitates the easy passage of the faeces. Absorption of water, salt and glucose takes-place in large intestine.

CHAPTER X.

Foods of Animal Origin.

Foods of animals origin include milk and milk products, eggs, fish, and meat. The chief characteristic of animal *foods is their richness in protein. Milk heads this class of foods.*

(I) *Milk.*—Milk is the most valuable food and indispensible at all ages. It is suitable for every climate and in health as well as in disease. This the main stay of a well-balanced diet of the masses of India and is the only animal food which can solve the protein problem of a hot and warm country like ours. Milk and not meat or eggs is the key to proper nutrition. It is the most nutritive of all foods. Milk proteins are rich in amino acids which are well adapted for promoting growth. Body can not manufacture certain amino acids like cystine, histidine, tryptophane, lysine, tyrosine, methionine and these amino-acids must be present in food if growth is to take place. Shortage of lysine causes suspension of growth which might continue for a long time with no apparent injury to health. Shortage of histidine or tryptophane will also cause cessation of growth and also endangers health. Methionine protects liver against chemical and bacterial poisons. Milk is rich in all these amino acids. Grains are

generally poor in these valuable aminoacids and this deficiency is best covered hy the addition of milk. Milk proteins in milk are associated with milk sugar which tends to protect the proteins from decomposition in the intestine. Lactose is much less susceptible to fermentation than any other sugar. *It helps the development of the lacto bacillus acido-philus in the intestine which suppresses* other putrifactive germs in the intestine. Many observers have noted the unique effect of milk in the promotion of growth. Corrymann selected 41 boys between the ages of 7—11 years and supplemented their diet with one pint of milk daily. A similar number of boys of similar age were kept on diet of equal caloric value but without milk, to serve as controls. The boys on milk gained in the first twelve months an average of 6·98 lbs. in weight and 2·63 inches in height per boy in contrast with the other boys acting as controls who gained only 3·85 lbs. in weight and 1·84 inches in height per boy.

This increased rate of growth in the boys on milk was maintained even in to the third year. The general nutrition of the boys improved considerably. The tendency to chil blains, roughness, of skin diminished greatly. The boys were more fit and became far more high spirited and irrepressible, being often in trouble on that account.

During that winter of the year there was complete absence of illness among the boys with the milk ration. Orr. made observations in Scotland on groups of school children, which showed that an addition of $\frac{3}{4}$—I pint of milk to the daily diet caused a rate of growth and weight 20 per cent higher than that of children who did not receive extra milk or who were given its caloric equivalent in the form of biscuits. Separated milk was found to be quite as effective as whole milk.

The value of milk is evident from a study of dietary of martial races of India.

The leading martial communities are Sikhs and Jats of Haryana. Sikhs do take meat but little. The main source of animal protein in their diets is milk or curds "*Lassi*" Jats of Haryana are wholly dependent on milk or curds for their supply of animal protein. This is evident from the proverb which describes Haryana "Jahan dud dehi ka khana" a place where milk and curds are eaten freely. Jats do not touch meat or eggs. Poor people get 'lassi' free from their well-to-do nieghbour and so every body gets proper quota of protein food.

In light of our present knowledge of Dietetics, supplies of milk less than one pint per head per day must certainly

be regarded as inadequate. The average consumption of milk by the people of the U. S. A. is a little over one pint per head per day, while in India it is hardly 5 oz. per capita per day. McCollum advocates the use of at least a quart or 24 ounces of milk per capita per day. "A quart of milk a day for every child" and "at least a pint for every adult" is the golden rule advocated by Sherman. In feeding of children milk should be used freely because it is a great body builder and promoter of growth and it is always good to continue liberal consumption of milk throught out life.

The New York Association for Improving the condition of the Poor carried out an extended series of experiments upon children from 3 years to over 13 years of age to determine the quantity of milk per day calculated to promote optimum growth. It was found that at all ages studied (3—13 years) the child should be fed a full quart of milk per day in order to ensure the best growth and development. Sherman carried out experiments on rats for several generations and applying the results of these experiments in human beings concluded that starting with a dietary already adequate according to current standards, an increase in the proportion of milk up to approximately the equivalent of a quart of milk per day for every person greatly favours growth and development in the young and

confers improved health and vigor throughout adult life and prevents premature old age.

It was to ensure an adequate supply of this valuable food—milk that Hindus give so much veneration to the Cow. The dairy cow is the most economical animal which converts grasses and the by-products of grain in to milk. The average return in protein and energy values is about 3—4 times as much as is obtained from animals fed for slaughter. More-over milk is rich in vitamins and minerals where as opposite is the case for meat. Hence leaving the religion and morality apart, Science can not justify meat eating, what to say of eating beef.

Chemical Composition.

As a typical example cow's milk is taken.

(1) *The Proteins.*—Average amount 3—3½%. From $\frac{3}{4}$—$\frac{3}{5}$ of the proteins of cow's milk consists of caseinogen and most of the remainder lactalbumin. Caseinogen or casein is the best known of the phospho proteins. Lactalbumin is rich in sulphur. Proteins of milk are richer than those of most other foods in lysine and tryptophane which are growth promoting.

(2) *Fat.*—average amount 3½—4%. It is present in highly emulsified form. Milk fat is rich in butyric acid.

Chemical Composition.

(3) *Carbohydrate.*—Lactose is present from 4-5%. Lactose is much less susceptible to fermentation than any other sugar.

(4) *Minerals.*—Milk is rich in valuable minerals.

i. Sulphur. 0·03% a constituent of milk proteins.

ii. Phosphorus 0·10%. Out of this 65% of the phosphorus of milk is in the form of phosphate, 25% combined with casein, and about 10% in the form of phosphatids of milk.

iii. Calcium 0·12%. Milk contains slightly more calcium, volume for volume, than does limewater (680 mg. per pint).

iv. Iron. Milk is poor in iron.

(5) *Vitamins.*—Milk is rich in vitamins. Each 100 grammes or 3½ oz. of milk contain :—

a.	Vitamin A	180	units.
b,	Vitamin B_1	17	"
e.	Vitamin C	2	"
d.	Vitamin D	2	"

e. also riboflavin and nicotinic acid.

(6) Water amounts 87-88% caloric value 20 calories per ounce.

Raw Milk.

Milk from a perfectly healthy cow is free from pathogenic germs but disease is very common in the animal. Two most common diseases whose germs are excreted in milk are:—

(1) Bovine Tuberculosis. (2) Undulent fever.

Far more commonly the milk gets infected after it is withdrawn. The germs grow and multiply very rapidly in milk and in short time bacteria to the extent of 1,000,000 per c.c. may be present. Following are the diseases which are milk borne:—

(1) Typhoid.
(2) Diarrhoea and Dysentery.
(3) Cholera.
(4) Food poisoning.
(5) Diphtheria.
(6) Sore throat.
(7) Scarlet fever.

To over-come this defect milk must be sterilized. There are two methods:—

(1) Pasteurization. (2) Boiling.

Pasteurization.—This consists in quickly raising the

temperature of the milk to 145°F (65·5)°C, maintaining it at that level for half an hour and then rapidly cooling.

Pasteurization destroys all pathogenic germs including the tubercle bacillus. There is no difference between the value of raw milk and pasteurized milk, excepting little loss of vitamin C which is already too little in it and some loss in vitamin B_1; vitamin A is unaffected.

Boiling.

This is the method most commonly used in our country. Vitamins are destroyed a good deal. Boiled milk clots more slowly in stomach, gives less dense clot than raw or pasteurized milk and so is more digestible.

Digestion and absorption of milk.

In the stomach:—Renin in the stomach changes milk into a solid clot. Renin splits caseinogen into casein and albumose. Casein combines with calcium to produce the clot which is calcium caseinate. This clot shrinks into a tough and leathery mass which requires great effort on the part of stomach to digest it. If this solid clot could be altered the milk will become more digestible in stomach. This is achieved in the following ways:—

(1) By dilution with water or barley water. This

decreases the amount of caseinogen and soluble calcium salts.

(2) *Adding sodium citrate. I Gr. of sodium citrate is added to I oz. of milk. It precipitates the soluble calcium salts as calcium citrate.*

(3) By "aeration". Adding aerated water to milk (the so-called "milk and Soda") makes it more digestible by diluting the milk and making the gas bubbles to come between the clot and so decreasing its toughness.

(4) By mixing it with other foods. Flour starch, biscuits, dalia, rice etc. added to milk act by preventing the running of clots into a tough mass.

(5) Curdling the milk before hand. Dilute acid such as acetic acid, citric acid or hydro chloric acid is added to the milk. The acid combines with the calcium salts and turns out the caseinogen from its partnership with calcium salts. Caseinogen is thrown down as a precipitate.

Milk on reaching the small intestine is acted by the pancreatic juice. Even if milk is not satisfactorily dealt with in stomach, it is sure to be digested in the small intes-

tine. Milk is fairly well absorbed with lesser expenditure of energy—with less wear and tear upon the part of the intestine, than any other food (Pavlov). Casein is the best absorbed of proteins. In children the absorbtion is much more than in adults. In adults milk given by itself as the exclusive diet is not very well absorbed; some 10% goes to wastage. Milk in mixed diet is much better absorbed. Milk alone is not suitable for adults as it becomes too bulky and lacks iron. But it is an indispensible addition to the diet. It is a very cheap source of first class protein. One quart of milk is equal to one pound of lean meat in protein. Milk hinders intestinal putrefaction as well.

Milk Preparations.

(1) *Rabri.*—It is a semisold preparation. Milk is heated, and stirred constantly till by the loss of water in vapours it becomes thick like porridge. Sugar is added and eaten. This is a valueable source of protein and calcium.

(2) *Khuwa and Mawa.*—Heating and condensing of milk is carried further till a semisolid mass results. This is taken with sugar. It is also a valuable source of protein and calcium.

(3) *Dahi or curds.*—Milk is boiled and inoculated

with a little curds and kept at room temperature. After *some time the caseinogen gets precipitated in 6-12 hours and the milk becomes sour due to lactic acid bacilli fermentation.* Curds are easily digestible and is a good source of protein and calcium. Lactose of milk becomes changed into laetic acid.

(4) *Lassi*—Curds are churned with water. The caseinogen is broken in smaller particles and so becomes easily absorable. By churning fat is removed.

(5) *Indian Cheese.*—Curds are put in a muslin cloth and hanged up for sometime to remove water. In this way we get a semisolid preparation of caseinogen. This is very tasty and easily digested. It is a good source of protein. Some calcium salts and other minerals pass out in the water. This is a very good way of giving concentrated preparation of caseinogen. It may be eaten with sugar or bread.

(6) *Malai.*—When milk is heated some milk proteins get coagulated, some fat which rises on the top also gets entangled. This is removed in the form of a film. The milk is continued to be heated, again film forms and this is removed. Malai is very tasty and contains protein and fat.

(7) *Whey.*—Whey is the fluid which is left after the clot has been removed from clotted milk. Clotting of casein is carried by the help of rennet. Acid may also be used to precipitate caseinogen.

The composition of whey is:—

Water	93·64%
Protein	0·82%
Fat	0·24%
Sugar	4·65%
Mineral matter	0·65%

This is a fluid of very poor nutritive value and is practically useless in the feeding of any disease. Formerly it was used in typhoid and often starved the patient to death.

Cream.—When milk is allowed to stand for a time, fat globules rise to the surface. This top portion is called cream. Cream is also formed by centrifugalising the milk. The former method is called skimming and cream contains about 20% fat. The latter is called separator cream or centrifugal cream. It contains fat about 65%. Cream also contains protein and sugar in the same proportion as in milk.

Cream is highly nourishing. It is a very good source of assimilable fat. Caloric value is 70C per oz. But

prepared from infected milk or raw milk, it is a very great source of disease. It should be prepared from pasteurized milk.

Skim milk.—This is milk from which cream has been removed after allowing the milk to stand for some time. This is same in composition as milk in which fat is left to the extent of ½-1%. Dried skim milk can be a very cheap source of first class protein. In the U. S. A. some 60 billion pounds of skim milk is produced annually but around 50 billion pounds remains on the farms and is fed to calves, pigs and poultry. The nutrients in skim milk, pound for pound equal those of muscle meat and it appears that 10 pounds of the nutrients of skim milk is required to produce 1 pound of food nutrients in the form of pork. Dried skim milk can be mixed with other foods in cooking.

Separated milk.—This is the milk from which the cream is removed by means of a centrifugal separator. The fat left is only ⅓%.

Butter milk.—Butter milk is the fluid which is left after the fat has been removed from cream by churning. It contains protein from 3%-3·7%. Fat 0·4-0·7%, carbohydrates 3·7-4·8%. It is easily digested and is nourishing.

Cheese.

Skim milk, separated milk and butter milk are cheap sources of first class protein. For promoting growth in height and weight they are as valuable as whole milk.

Cheese.

Cheese is prepared in two ways:—

(1) Amount of fat in cheese depends on whether the milk used is whole milk or separated milk.
Cheddar cheese. Whole milk is used. It contains protein 33·4% and fat 26·8%.
Dutch cheese. It is prepared from skim milk. It contains protein 30·8% and fat 17·8%.
Stilton cheese. Cream is added to the milk and so it contains greater amount of fat Protein 24% and fat 39%. Rennet is used to coagulate casein.

(2) The caseinogen is precipitated by the fermantation of lactic acid or by adding acid. It contains less fat than cheese made from milk clotted by the help of rennet.

If high pressure is used to remove the whey the cheese so obtained is called hard cheese. If the pressure used to remove is no greater than the natural weight of the curd it is called "soft" cheese. Soft cheese does not keep well and so it must be used immediately.

Manufacture of cheese. Clean milk is taken and is kept at 86°F until the desired amount of lactic acid has formed, 0·20% of lactic acid is necessary for ripening milk completely. This milk is now coagulated with the help of rennet. Whey is removed, the curd is allowed to chheddar or solidify. It is salted and pressed and allowed to ripen for weeks or months. The temperature for ripening should not be above 55°F.

Cottage cheese is prepared by the help of acid, more calcium is lost in the whey.

After removal of the whey the cheese is allowed to "ripen" in a cool place. Before the present war cheese was allowed to ripen for 5-9 months at a temperature of about 50-60F. This time was sufficient to allow all pathogenic organisms, including tubercle bacilli to perish. During the war the ripening process has been shortened. This shortened time is not sufficient to kill the pathogenic germs and epidemics of diseases have been caused by the use of such cheese. Several cases of typhoid occurred due to the consumption of this immature cheese. The safest way is to use pasteurized milk for the preparation of cheese if it is not ripened properly.

Digestibility and nutritive value of cheese.

The digestibility of cheese depends on :—

(1) Amount of fat content.

(2) Size of lumps swallowed.

So cheese must be broken up before eating it or it may be chewed thoroughly. Once it reaches the intestine there is no difficulty in its digestion and absorption. It is absorbed to the extent of about 90%. Cheese is a very cheap source of protein. 2 oz. of cheese represents protein of 1 pint of milk. 1 lb. of cheese yields 1000 calories. 1 lb of cheese is equal to 3 lb. of meat.

Butter.

Butter is prepared from cream by churning. It contains 82% fat and 12-15% water. One ounce is equal to about $\frac{4}{5}$ oz. of pure fat. It contains vitamins A and D.

Butter fat contains butyric, caproic, caprylic and capric fatty acids which are soluble in water and so it is easily absorbed. It contains about 40% olein. For these reasons butter is easily absorbed and digested. One ounce of butter gives 200 calories. Butter must be prepared from pasteurized milk.

Ghee.

Ghee is prepared from butter made from curds.

Proteins and water is removed, it is pure fat of milk and so keeps well in hot climate. Vitamin A is present to the *extent of about 3,000 I-U units in 2 oz. of ghee (Highest amount recorded by D. D. Mitra 1939). During the process of cooking this amount* is reduced still further and the amount of 2 oz. of ghee daily is consumed by very few people. So as a source of vitamin A, ghee is not to be relied upon. Vegetable containing carotene are cheaper in this respect. Ghee is less easily digested than butter. 1 oz. yields 270 calories.

Milk of other animals.

(1) Goat's milk. (2) Buffaloe's milk.

Goat's milk:—Protein 3·7%, fat 5·6%, carbohydrate 4·7% and calcium 0·17%.

Goat's milk is richer than cow's milk but is not popular due to a peculiar odour.

Buffaloe's milk:—Protein 4·3%, fat 8·8%, carbohydrate 5·1% and calcium 0·21%.

Buffaloe's milk is very rich in protein, fat and calcium.

Eggs.

Next to milk eggs are very important in nutrition. Egg

proteins have the highest biological value. They are especially useful in wasting diseases, acute infections and during growth, pregnancy and lactation. They are concentrated form of high class protein and fat, calcium, phosphorus and iron as well as vitamins. The composition of eggs :—

	Water	Protein	Fat	Minerals
White	85·7%	12·6%	0·25%	0·59
Yolk	50·9%	16·2	31·75%	1·09
Total edible part	73·7%	14·8%	10·5%	1·0

A hen's egg weighs about 50 grammes. It contains 29 grammes of white and 15 grammes of yolk. The rest is shell. One egg furnishes the following amounts of vitamins and mineral.

(1)	Vitamin A.	132·0	units.
(2)	Vitamin D.	75	"
(3)	Vitamin B.	15	"
(4)	Riboflavin	0·2	mg.
(5)	Calcium	36	"
(6)	Iron	1·58	"
(7)	Phosphorus	140	"

Eggs are of two kinds (1) Fertile. (2) Infertile.

Fertile Eggs.—Give birth to chicken.

Infertile eggs.—Do not give birth to chiken and so the question of "taking life" does not arise. Infertile eggs are called "Vegetable eggs" and possess all the nourishing qualities of fertile eggs. These eggs may be taken by the orthodox. The two varieties of eggs are distinguished easily before breaking the egg. In fertile egg the air space is very small as compared with the air space in an infertile egg.

The Proteins of egg:—

(1) *The Egg white.*—It is a mixture of different proteins but is quite free from carbohydrates and contains very little fat so that it is absorbed very easily.

(2) *The Yolk.*—These proteins have high content of phosphorus and have relatively high proportion of amino-cids, cystines, typtophane and tyrosine which are very useful in nutrition. Eggs are aphrodisiacs.

The fat of egg.—It is a mixture of glycerides of fatty acids, lecithin and cholestrol. The fats are highly emulsified. It is rich in phosphorus, calcium, iron and vitamins A & D.

As compared to lean meat eggs have equal caloric value to lean meat. Protein in eggs and meat is 14·8% and 21·0% while fat is 10·5% and 5·5% respectively.

A fresh egg should sink in 10% solution of salt water,

Eggs.

Digestion of eggs. Soft boiled eggs are the most easily digested. Raw and poached eggs are digested with a little more difficulty while hard boiled eggs and omelete take longest time to be digested. 95% of eggs are absorbed only 5% residue is left. Eggs are free from purines.

Egg poisoning. Some people are sensitive to eggs. They get allergic phenomena like urticaria, asthma, etc.

Compared to other animal foods eggs are safest from the point of carrier of infection as the shell does not allow any infection to enter. But occasionally eggs give rise to serious food poisoning. Eggs become infected in two ways :—

(1) Through a crack in the shell. Some flies can pierce through the shell and infect the inside by their lute.

(2) Introduction of infection into the oviduct of the hen or duck during copulation with infection of the albumin as it is being deposited round the yolk. This infection is much more common in eggs of duck as it lives in dirty ponds.

Duck may suffer from epidemics of Salmonella infections and so the infection is transferred to eggs. Hen

may also suffer from Salmonella infection but it is much less common than in ducks. Dried eggs are generally free from these drawbacks as the infection is destroyed during the process of heating. Boiled eggs are also safe but boiling must be continued for at least 8 minutes if it is to be effective. Pasteurized frozen eggs are safe.

Eggs rank with milk as a source of vitamins and are richer than milk in iron but not so rich in calcium. In children's dietary eggs should only supplement the milk and should not be allowed to displace the milk to any appreciable extent. Eggs are very valuable food for adults who need to be "built up".

Fish.

Nutritive value of fish. Fish are very good source of protein and vitamin D. Fish is easily digestible and is cheap.

Composition.—This varies according to the amount of fat. Following are the characteristics of fish :—

(1) Amount of waste matter in the form of skin, scales, bones it may be from 35-70%.

(2) Amount of water. This is more than in meat.

(3) Large amount of gelatine in proteins. Gelatine is

an incomplete protein and lacks important aminoacids cystine, methionine and tryptophane but contains lysine and arginine. It becomes valuable only when mixed with other proteins, proteins of cereals or milk. Gelatine is very easily digested and so is very useful addition to the dietary of sick. Gelatine fixes hydrochloric acid also and so is very useful in peptic ulcer and hyper acidity. But as gelatine is taken in the form of jelly it can not be taken more than 1 oz in twenty four hours.

When fish is boiled lot of gelatine passes out so boiling is not a good method of cooking fish.

Fish contains fat from		1-15%
	Protein	8-15%
	Vitamin D. variable	
Cooked fish contains fat from		2-18%
	Protein	11-22%
	Vitamin D. variable	

Meat.—Meat offers a concentrated form of easily digestible protein. It is absorbed completely to the extent of 95%. The proteins are of high biological value. It has a high specific dynamic action which is harmful in a hot climate like ours. It is not a necessary constituent of diet.

Composition. Meat may be divided into lean, medium and very fat varieties. The composition is:—

	Water	Protein	Fat	Mineral
Lean	76%	21%	1½-2	1%
Medium	73%	20·5%	5-5%	1%
Very fat	53%	17%	20%	1%

Cooking of meat.

(1) *Boiling.*—The proteins become coagulated, the connective tissue is changed into gelatine, the fibers shrink and water is expressed out. Cooked meat is more easily digestible but overcooking makes it indigestible Extractives pass out of the fibers in the water boiled.

(2) *Roasting.*—Meat is heated directly on the fire. Water is lost by evaporation and there is very little loss of extractives. Fibers shrink and protein becomes coagulated and connective tissue is changed into gelatine.

(3) In baking heat is applied all round the meat at once.

(4) In stewing.—The temperature is not allowed to rise above 180°F.

Protein is the principal solid constituent of meat

Meats.

Proteins are of good nutritive value itself and also are nutritionally efficient in supplementing the proteins of bread. So far as protein alone is concerned, meat is about as efficient as milk and eggs in this respect, but it should always be kept in mind that bread needs supplementing with respect to mineral elements and vitamins much more than with respect to protein and as sources of mineral elements and vitamins meat does not take the place of milk and eggs.

Meat contains purine bodies.

Meat protein are more susceptible to putrefaction

Digestion of meat.—In the stomach the fibers of meat are separated, proteins are changed into meta proteins and albumoses. Meat does not put much strain on the stomach. The digestibility of meat depends on the length of its fibers and content of fat.

Overcooked meat becomes indigestible. Meat contains lot of purines. In the small intestine meat is acted upon by the pancreatic juice and intestinal juice and meta proteins and albumoses are changed into aminoacids. About 95% of meat is absorbed.

Animal Organs Used as Food.

(1) *Liver.*—Liver contain 20-24% of protein. It

is rich in vitamin A which is present to the extent of from 70-1600 units per gram and Nicotinic acid. Iron and hoemopoietic principle make it valuable in macrocytic anaemias. It is rich in purines. It is less easily digested than ordinary meat.

(2) Testicles are eaten for aphrodisiac properties. Any aphrodisiac action due to internal secretion is not likely to take place as the internal secretion is destroyed on oral use.

(3) Kidneys are rich in nucleoproteins

(4) *Heart.*—It is like ordinary meat but less digestible.

(5) Lungs are generally not eaten. They contain lot of connective tissue.

(6) Pancreas or Sweet bread. It is easily digested contains lot of nucleoproteins.

(7) Stomach and intestines.— They contain large amount of connective tissue, are easily digested.

(8) Brain. —It contains, phosphorus, lecithin, cholestrol etc.

It is easily digested but poorly absorbed.

Meat Preparations.

(1) *Meat Soup.*—Meat soup contains 95%—98% of water and $1\frac{1}{2}$%—5% solids. The real nutritive value of soup is negligible but it acts as flavouring and appetizing agent.

(2) *Meat Extracts.*—Meat extracts have very little nutritive value. They aid digestion due to their flavour. Some proprietary brands of meat extracts contain proteins and their body building and caloric value is proportionate to the amount of proteins but for all practical purposes they should be regarded as merely flavouring agents.

(3) *Meat Juices.*—They contain coagulable proteins. mineral matter and extractives. Proteins vary from. 2-7% and so the nutritive value is small.

(4) *Meat Tea or Beef tea.*—It is a flavouring agent.

(5) *Meat powders.*—They are prepared by dehydrating meat. They are useful in feeding the sick.

CHAPTER XI.

Foods of Vegetable Origin.

Chemical composition.—Vegetable foods are composed of:—

(1) Carbohydrates (2) Proteins (3) Fats (4) Cellulose and allied material (5) Inorganic salts (6) Vitamins and (7) Water.

The chief characteristic of vegetable foods is the large amount of cellulose and allied material and water they contains. Cellulose and the allied material form the frame work enclosing nutrient materials and these are not acted by gastric juices and are not absorbed. The process of cooking makes this frame work break up and makes the contained nutrient material more accessible to digestive juices.

This excessive content of water and cellulose and allied materials give bulk to the vegetable foods. This bulkiness has important bearing on the digestion and absorption of food:—

(1) There is greater difficulty for digestive juices to penetrate to the nutrient material and so greater difficulty in digestion.

(2) There is greater mechanical strain on the digestive organs in handling this greater bulk.

(3) The peristalsis is stimulated and so there is lesser complete absorption of the nutrient material.

Classification:—

(1) The cereals	(2) The Pulses
(3) Nuts	(4) Roots and Tubers
(5) Green vegetables	(6) Fruits.

Cereals.

Cereals are the chief sources of supply of carbohydrates.

The chief form of carbohydrate present is starch which is present to the extent of 65-70%.

Proteins are also present in cereals to a very appreciable extent about 10-12%.

Fat.—Cereals are poor in fat 1·6-5·5%.

Inorganic Salts.—About 2%. It is mostly calcium and phosphorus but phosphorus is not available to the body, being present in the phytin form. Cereals have rachitogenic effect which is corrected by giving vitamin D. This property of antagonising the calcification of bones or teeth or of producing rickets lies in the bran and germ of cereals.

Water. .— 10-12%.

Proteins of cereals.—Some of the cereal proteins are deficient in essential amino acids; such as zein from maize which lacks in trypto phane, hordein from barley or gliadin from wheat which are deficient in lysine. Zien is not sufficient for the needs either of a growing or a full grown animal, hordein or gliadin can maintain the health of full-grown animal but do not support growth. But in practice this is of no importance. Maize contains other proteins besides zein, barley or wheat also contain other proteins besides hordein and gliadin and this mixture of proteins in each grain contains all the deficient aminoacids absent from these particular proteins. Therefore the individual grain is quite sufficient for growth and maintenance of health. Mccollum after an extended series of experiments has found that wheat and maize are very similar in their dietary properties. Osborne and Mendel have also found the proteins of barley, oats, rye and wheat to be equally efficient in promoting and supporting growth. Sherman's experiments on human beings showed wheat, maize and oat proteins to be equally efficient in human nutrition. But cereal proteins are somewhat inferior to an equal weight of the mixture of proteins derived from milk, eggs or meat. Milk proteins are relatively rich in those aminoacids in which the grains are poor. Osborne and

Mendel found that a mixture of 75% zien and 25% lactalbumin maintained the animals in health and vigour and promoted their normal rate of growth. If bread is made with milk instead of water or breakfast cereal is taken with cream or milk, the protein of the combination may have fully as high a nutritive value as the proteins of an ordinary mixed diet.

The digestibility of the grain proteins. Pure grain protein is probably not inferior to animal protein but the presence of cellulose in the grain, slightly lowers its digestibility and absorption. Whole wheat products are slightly less digestible than the finer products and the amount of available protein and carbohydrates are equal in the two. But whole grain products remain superior in minerals and vitamin B.

The minerals. - The minerals of the cereals are largely concentrated in the germ and outer layers. Three-fourths of the mineral matter of the wheat kernel are lost to man in the process of manufacturing the wheat into white flour, but in assimilation the loss of minerals is not quite in this ratio as much less is absorbed from the whole wheat. The body probably absorbs from a pound of whole wheat bread about twice as much minerals as from a pound of white bread (Sherman). Bunge tested the effect of white

bread and whole wheat bread on growing rats. The rats receiving the whole wheat grew much better than those receiving white bread.

Vitamins.—Cereals are rich in vitamin B. Osborne and Mendel found that a ground whole grain such as wheat, maize or barley, fed in the proportion of 15-25% of the total weight of food consumed, will furnish an amount of vitamin B adequate for normal nutrition, thus indicating that the whole grains are 4—7 times as rich in vitamin B as the diet as a whole needs to be. Vitamin G. is also present in the whole grains.

Whole grain is much superior to highly milled products in protein and vitamin content. Supplementing of the cereals by milk was found to increase their nutritive value. Osborne and Mendel found that even a small proportion of milk constituents, such as introduced by the use of milk in place of water in bread making, had a marked influence on the nutritive value of bread. The results were, however, progressively better with increasing proportions of milk in the diet upto at least $\frac{1}{3}$ of the total solids of the food. With milk constituting $\frac{1}{3}$ of the total solids of the food intake, almost equally good growth resulted whether the remainder of the diet were whole wheat or patent flour. But if the milk was decreased, the superiority of whole

wheat to patent flour was striking. The whole grain was found markedly superior to patent-flour for the support of reproduction and lactation in laboratory animals.

Patent-flour is much more completely digested and absorbed than the whole wheat flour but this is more than compensated by the superiority of the whole wheat product in its mineral and vitamin content and in the nature of its proteins.

Wheat.

This is the best of cereals. It is highly nutritious Composition.—water 12·8%, protein 11·8%, fat 1·5%, carbohydrate 71·2%, calcium 0·05%, iron 5·3 mg. %, carotene 108 units per 100 gms., vitamin B_1 180 units per 100 gms.

The whole grain consists of three parts :—

(1) *The bran.*—This is rich in cellulose. It also contains minerals and vitamins.

(2) *Germ.*—Germ is rich in vitamins, proteins, minerals and fats.

(3) *The kernel.*—It mostly contains starch and proteins. In stone grinding only bran is removed. In roller milling bran and germ both are removed.

		Whole Wheat Flour	White Flour.
Protein	%	13·0	10·8
Carbohydratcs	%	72·4	75·9
Fat	%	2·0	0·9
Crude fiber	%	1·8	0·3
Calories per 100 gm.		3·60	3·40
		mg./lb.	mg./lb.
Thiamine		2·20	0·35
Riboflavin		0·50	0 15
Nicotinic acid		26·76	4·54
Pantothenic acid		6·03	2·59
Pyridoxine		2·09	0·99
Iron		18·00	3·00

Average daily consumption of 7 ounces of wheat flour supplies 22 Gm. of protein daily.

The above table shows the large milling losses of vitamins and minerals. In America the white flour is now enriched by addition of vitamins and iron so that Thiamine content is 1·66 mg., Riboflavin, 1·20 mg. Iron 6 00 mg., Nicotinic acid 6·00 mg., per lb.

Bread.—It contains 40-50% water. Bread is either made by the use of yeast or baking powders.

(1) Yeast causes liberation of carbonic acid gas which

raises the flour and is the cause of sponginess of the bread. Some starch is converted into dextrin as well.

(2) *Baking powders.*—These consist of tartaric acid or potassium acid tartrate with sodium bicarbonate. carbonic acid gas is liberated by chemical action. The use of baking powders is harmful as alkali destroys vitamin B_1 in the flour.

Brown bread.—It is made from whole wheat flour Its composition is:—

Water	45	%
Protein	6·3	%
Fat	1·2	%
Carbohydrates	44·8	%
Cellulose	1·5	%
Ash	1·2	%

White Bread.—In white bread bran and germ are excluded. The composition is :—

Water	40·0	%
Protein	6·5	%
Fat	1·0	%
Carbohydrates	51·2	%
Cellulose	0·3	%
Ash	1·0	%

Indian chapatis.—Mostly they are made from flour of cereals, wheat or maize. In some places yeast is also added to the dough which is allowed to be fermented. Gram flour is also added some-times in a little quantity, which increases the protein content of the *chapati* and makes it more digestible.

Composition of *chapati*, protein 2.6, fat 1.0, carbohydrate 20, water 70, caloric value 100 per oz.

Oats.

Oats are not eaten in our country as it grows in temperate climates. Oats are rich in fat and purines.

Composition :—Oat meal.

Moisture	10·7 %
Protein	13·6 %
Fat	7·6 %
Cellulose	3·5 %
Carbohydrate	62·8 %
Iron	3·8 mg. %
Vitamin B_1	325 units per 100 gms.

The husk is not removed easily on grinding. so rolling is used which breaks the husk and flattens the grain.

Barley.

Composition:—Moisture	12·5	%
Protein	11·5	%
Fat	1·3	%
Cellulose	3·9	%
Carbohydrate	69·3	%
Iron	3·7 mg.	%
Vitamin B_1	150 units per 100 gms.	

The chief defect in barley is the presence of husk. Roasted barley are delicious to take, the husk gets removed during roasting. Another preparation is *Sattu.*

Barley water is useless as a nutrient. It is given to the sick for its demulcent properties.

Rice.—Rice is the staple food of a large proportion of mankind. Beri beri is associated with a diet largely composed of milled rice.

Composition of rice: Protein 7—8.5 per cent, carbohydrate 77—79 per cent, fat 0.4-0.6, per cent, calcium .01 per cent, Iron 1—2.8 mgm, per cent.

Nutritive value of rice.

(1) ***Protein.***—Rice contains lower protein content than wheat and other cereals. But rice proteins

have a fairly high "biological value" and for this reason protein deficiency is not considered to be an important defect of typical rice diets by some observers.

(2) Low fat content is of no importance.

(3) Rice is a poor source of calcium and iron and these are serious defects of a rice diet.

(4) *Vitamins. Rice is poor in vitamin A. Vitamin B_1* content *depends* upon the milling and preparation of rice for food. The germ and pericarp of cereals contain most of the vitamins and minerals. Raw machine rice is deprived of the germ and almost all its pericarp and therefore it is very poor in vitamin B_1 and minerals. The process of hand-pounding does not remove the whole of the pericarp. The germ is usually lost, but typical hand-pounded rice usually retains some 50-75 per cent of its pericarp. Parboiled rice retains some of the vitamins and other nutritive substances because during the process of "Par-boiling" some of the vitamins and other nutritive substances contained in the germ and pericarp diffuse through the grain and can not be removed by subsequent milling. So milled

parboiled rice has a higher nutritive value than the raw milled rice.

Rice is usually washed several times before cooking and boiled in excess of water. *Frequent washing and discarding of cooking water results in very great loss of vitamin B_1 and minerals.* So it is better to *avoid washing* and *boiling in excess of water.*

Parboiled rice, whether under milled or highly milled, usually prevents beri beri because it contains the vitamin B_1 in sufficient quantities. But it should not be washed frequently before cooking and boiled in excess of water.

Bajra or Cambu.

Composition	-Moisture	12·4 %
	Protein	11·6 %
	Fat	5 %
	Cellulose	1·2 %
	Carbohydrate	67·1 %
	Iron	8·8 mg. per cent.
	Carotene	220 units per 100 gms.
	Vitamin B_1	110 units per 100 gms.

Bajra is highly nourishing it is the staple diet of agriculturists of Southern Punjab.

Cholam or Juwār.

Composition:—	Moisture	11·9 %
	Protein	10·4 %
	Fat	1·9 %
	Carbohydrate	74·0 %
	Iron	6·2 mg. per cent.
	Carotene	136 units per 100 gms.
	B_1	115 units per 100 gms.

Juwar is slightly poorer in protein than wheat but richer in carbohydrate. Roasted *juwar* is commonly eaten as a dietary supplement and is fairly delicious.

The Pulses.

The pulses include peas, beans and lentils. They are very good sources of protein. Proteins of pulses are inferior to those of cereals. The pulses are not readily digested by the stomach—about 4-4½ hours are taken. Absorption depends on the state of division. If finely divided as in the form of flour 90-92% is absorbed.

Nutritive value of pulses.—The proteins of pulses are poor in cystine (Johns and Jones) but otherwise they are similar to the proteins of meats and fish in their amino-acid make-up. Pulses also furnish liberal quantities of

phosphorus, iron and somewhat less abundant amounts of calcium. Pulses are approximately twice as rich in protein as the cereals.

Pulses are rich in carbohydrates also but poor in fat. Pulses are never eaten alone. They are eaten with cereals. The nutritive value of the pulses is high. They are good supplements to increase protein deficiency diets containing excessive rice.

(1) *Red gram. The pigeon pea. The Dal Arhar (Cajanus Indicus).*

The composition is Moisture 15·2%, Protein 22·3%, Fat 1·7%, Carbohydrate 57·2%, Calcium 0·14%, Iron 8·8 mg.%, Carotene 220 units per 100 gms., Vitamin B_1 150 units per 100 grams.

This is one of the best and easily digested pulses.

(2) *Gram or Chick pea (Chana) Cicer Arietinum.*

The Composition is:—Moisture 9·8%, Protein 17·1%, Fat 5·3%, Carbohydrate 61·2%, Calcium 0·19%, Iron 9·8 mg.%, Carotene 316 units per 100 gms., Vitamins B_1 100 units per 100 grams.

Gram is a very common addition to cereal diet, gram whole or crushed into two is taken in the form of *dal* or soup. *Dal* is usually mixed with other *dals*. This is not a good way of taking it as it is indigestible and absorption is poor.

Gram flour is added to wheat flour to make *chappatis* It increases the protein content of *chappatis* and makes them more digestible because a pure wheat *chappati* due to excessive glutean is not easily penetrated by digestive juices. The best way to use gram is in the form of curry—a dish prepared from the gram flour and is eaten with cereals or rice. Fine state of division makes it easily digested and well absorbed.

Roasted grams are commonly taken as dietary supplements.

(3) The Lablab-bean (*Lobia*) D. Lablab.

Composition:—Moisture 9·6%, Protein 24·9%, Carbohydrate 60·1%, Calcium 0·06%, Iron 2·0 mg.%, Carotene and B_1 little.

(4) Glycine Soya. *Soya Bean.* It is very rich in protein and fat. Protein 35, carbohydrate 20 and fat 17 per cent. Soya Bean protein

has high boliogical value and it approaches the animal proteins in this respect. Horyath says, "The Soya bean protein is a complete protein containing all the essential amino-acids necessary for the building up of the protein of the human organs." It is rich in vitamin A and B_1 also.

Soya Bean Milk. Soya beans are washed thoroughly and soaked in cold water for 12 hours, changing the water frequently. Then the beans are ground in a stone mill adding small amounts of water while grinding. The total amount of water added is from three to five times that of the beans. The thin paste-like fluid is boiled for about one hour and filtrate is the soya bean milk.

Another method of preparing Soya bean milk is :—

To the bean meal is added five times its bulk of water, it is then inoculated with B coli and B. Lactis aerogenes and left to stand for 16 hours at room temperature. At the end of this time it is boiled for one hour, filtered through a fine cheese cloth and to it is added salt in the proportion of one half teaspoonful to one quart of the milk. Five per cent milk sugar is added, if desired.

Composition of Soya-bean milk. Protein 3–5 per cent, Fat 2—3 per cent, Carbohydrate 00·3—3 per cent, Minerals 0·41—0·5 per cent.

Hill and Stuart of Harward Medical School fed 40 babies with *soya bean milk* and the babies thrived on it. As the soya bean milk is deficient in minerals, the addition of 2 grams of calcium carbonate and 1 gram of sodium chloride to every 100 grams of soya beans used for making milk will be needed.

Liberal use of *soya beans* in the diet deficient in high class and costly proteins offers a solution of protein deficiency. Experiments by different food experts indicate that 20 per cent soya beans and 80 per cent rice provide a well balanced diet as far as protein and fat requirements are concerned.

It is very rich in proteins and fats and Vitamins.

Composition :—Water 8·1%, Protein 43·2%, Fat 19·5%. Carbohydrate 20·9%, Calcium 0·24%, Iron 11·5 mg.%, Carotene 710 units per 100 grams Vitamin B_1 300 units per 100 grams.

(5) Lentil (*Masur*) Lens Esculenta.

Composition :—Water 12·4%, Protein 25·1%, Fat 0·7%. Carbohydrate 59·7, Calcium 0·13%, Iron 2 mg.%, Carotene 450 units per 100 gms., Vitamin B_1 150 units per 100 gms.

(6) Phaseolus aconitifolius (*Moth*).

Water 15%, Protein 23·8%, Carbohydrate 56·6%, Fat 0·6%.

(7) The green Gram (*Mung*) Phaseolus Mungo.

Composition :—Water 10·9%, Protein 24·0%, Fat 1·4%, Carbohydrate 60·3%, Calcium 0·20%, Iron 9·8 mg.%, Carotene 64 units per 100 gms. B_1 140 units per 100 gms.

It is easily digested.

(8) Black gram (*Urd*) Phaseolus Radiatus.

Composition :—Water 10·4%, Protein 24·0%, Carbohydrate 56·6%, Calcium 0·14%, Iron 8·4 mg.%, Carotene 158 units per 100 gms. B_1 155 units per 100 gms.

(9) The Garden Pea (*Matar*) Pisum Sativum.

Composition:—Dry Pea Water 16%, Protein 19·7%, Fat 1·1%, Carbohydrate 56·6%, Calcium 0·07%, Iron 4·4 mg.%, Vitamin B_1 150 units per 100 gms.

Green Pea.—Protein 5·8%, Carbohydrate 10·6%, *Vitamin A (Carotene) 139 Units per 100 gms.,* Vitamin C 96 units per 100 gms.

(10) *Rawan*. Vigna Catiang.

Water 12·7%, Protein 2·34%, Fat 1·3%, Carbohydrate 59·7%, Calcium 0·08%, Iron 4·3 mg.%

Nuts.

Nuts are rich in fat and proteins. They are rather difficult to digest. Their protein is inferior to those of pulses.

Nutritive value of nuts.—The nut proteins have an amino-acid make-up similar to that of meat and fish. Coconut protein was found by feeding experiments to furnish all the essential amino-acids (*Johns et al*). Shiba and Koyama found pea nut proteins somewhat more efficient than soya bean protein in the support of growth. Almond and walnut are quite efficient for human

nutrition. Eddy and Eckman found peanut flour slightly superior to the meat as a growth producer and markedly for promoting reproduction. Pea–nut flour was found to be quite digestible. The digestibility co-efficient of protein was found to be 89%, fat 96%, carbohydrate 97% (Johns). Johns and Fink found that bread made with a mixture of 25% pea-nut flour and 75% wheat flour funished adequate proteins and water soluble vitamins for normal growth.

Nuts are rich sources of phosphorus, good sources of iron, poor or fair sources of calcium. They are good sources of vitamin B_1. Nuts are rich in protein and fat and are comparable to meat as food and may be used interchangeably with meat in diet. They are good substitute for meats but not for milk or eggs.

Cashew-nut roasted.—Composition :—Moisture 5·9%, Protein 21·2%, Fat 46·9%, Carbohydrate 22·3%, Calcium 0·05%, Iron 5·0 mg. %, Carotene 100 units per 100 gms.

Cashew-nut raw. Composition:—Moisture 19·0%, Protein 15·35%, Fat 41·0%, Carbohydrate 12%. Calcium 0·05%. Iron 5·0 mg.%, Carotene 100 units per 100 gms.

(2) Almonds (*Badam*).

Composition :—Water 5·2%, Protein 20·8%, Fat 58·9%, Carbohydrate 10·5%, Calcium 0·23%, Iron 3·5 mg.%, Vitamin B_1 80 units per 100 gms.

Almond milk is a very common drink in hot weather in India. Almond milk is also useful in feeding infants. It is prepared by soaking kernel of almonds in water and then grinding them in water.

(3) Ground nut. Pea-nut.

Composition :—Raw-water 7·9%, Protein 26·7%, Fat 40·1%, Carbohydrate 20·3%, Calcium 0·05%, Iron 1·6 mg.%, Carotene 63 units per 100 gms., B_1 300 units per 100 gms.

Ground nut roasted-water 4·0%, Protein 31·5%, Fat 39·8%, Carbohydrate 19·3%, Calcium 0·05%, Iron 1 mg. %.

Oil is expressed from gound-nuts and is eaten as such or used in the manufacture of artificial ghee or artificial butter. Vitamin B_1 is destroyed in roasted ground-nuts. It is much better to soak the kernel of ground-nut in a little water overnight and eat in this raw softened state.

Ground-nut milk can also be prepared by grinding them with water. Ground-nuts are more nourishing than almonds.

(4) *Walnut.*

Composition :—Water 4·5%, Protein 15·6%, Fat 64·5%, Carbohydrate 11·0%, Calcium 0·10%, Iron 4·8 mg.%, B_1 150 units per 100 gms.

Singhara. Water-nut or Trapa Bispinosa Dry.

Composition :—Water 13·8%, Protein 13·4%, Fat 0·8%, Carbohydrate 68·9%, Calcium 0·07%, Iron 2·4 mg. per cent.

This is eaten on the occasion of festivals.

Green. Composition :—Water 70%, Protein 4·7%, Fat 0·3%, Carbohydrate 23·9%, Calcium 0·02%, Iron 0·8 mg. per cent.

Green nuts are commonly eaten and are delicious. They are good source of protein.

Roots and Tubers.

Roots and tubers are rich sources of carbohydrates. Protein and fat are found in small amounts. They are fairly good sources of minerals and vitamins.

(I) *Potatoes.*

Composition :—Water 74·7%, Protein 1·6%, Fat 0·1%, Carbohydrate 22 9%, Calcium 0·01%, Iron 0·7 mg.%, Carotene 40 units per 100 gms., B_1 20 units per 100 gms. Vitamin C 17 mg., per 100 gms.

Potatoes contain proteins appoximately 10% of the total calories and these proteins are of good biologic value. They are low in fibre and are highly digestible. They are good source of iron as well, one medium-size potatoe may provide 1—1·5 mg. of iron.

Potatoes are rich in starch and potassium. Potatoes are fairly good source of Vitamins B_1 and C. There is a loss of $\frac{1}{4}$—$\frac{1}{3}$ of vitamin C on boiling and of one-quarter of the vitamin B_1 If potatoes are boiled in their skin the loss of vitamin will be much less. About 8 ounces of potatoes a day will prevent scurvy in an adult and in many countries of temperate climate potatoes are the main source of vitamin C in the diet. Prolonged heating, repeated heating steaming cause greater destruction of vitamins. Boiled potatoes are easily digested and very well absorbed. But as sole constituent of diet they are too bulky.

Sweet potato.—Composition :—Water 66·5%, Potein 1·2%, Fat 0·3%, Carbohydrate 31·0%, Calcium 0·02%, Iron 0·8 mg. %, Carotene 10 units per 100 gms., vitamin C 24 mg. per 100 gms.

The sweet potato is primarily an energy food, low in fiber and highly digestible, 6% of the total calories are in the form of protein. They are rich in vitamin A. 100 gms. of cooked product supply 3460 units (Booher). They are poor in iron.

Beet root.—Composition :—Water 83·8%, Protein 1·7%, Fat 0·1%, Carbohydrate 13·6%, Calcium 0·20%, Iron 1 mg.%, Vitamin B_1 70 units per 100 gms., Vitamin C 88 mg. per 100 gms.

Carrots.—Composition :—Water 86·0%, Protein 0·9%, Fat 0·1%, Carbohydrate 10·7%, Calcium 0·08%, Iron 1·5 mg.%, Carotene 2000—10000 units per 100 gms., Vitamin B_1 60 units per 100 gms., Vitamin C 3 mg. per 100 gms.

Carrots are very good source of vitamin A.

Turnip.—Composition :—Water 91·1%, Protein 0·5%, Fat 0·2%, Carbohydrate 7·6%, Calcium

0·03%, Iron 0·4 mg per cent. Vitamin B_1 40 units per 100 gms. Vitamin C 43 mg. per 100 gms.

Turnips are good source of vitamin C.

Radish (*Muli*).—Composition :—Water 94·4%, Protein 0·7%, Fat 0·1%, Carbohydrate 7·4%, Calcium 0·05%, Iron 0·4 mg.% Vitamin B_1, 60 units per 100 gms., Vitamin C 16 mg. per 100 gms.

Onion is used as a flavouring agent and gastric stimulant. It contains vitamin B_1 40 units per 100 gms. Vitamin C 11 mg. per 100 gms.

Tapoica.

Composition :—Water 59·4%, Protein 0·7%, Fat 0·2%, Carbohydrate 38·7%, Calcium 0·05%, Iron 0·9 mg. per cent.

Tapoica is mainly starch and very poor in protein.

Sago.

Composition :—Water 12·2%, Protein 0·2%, Fat 0·2%, Carbohydrate 87·1%, Calcium 0·02%, Iron 1·3 mg. per cent.

Sago.

Sago is pure starch and is easily digestible.

Arrowroot.

Composition :—Water 16·5%, Protein 0·2%, Fat 0·1%, Carbohydrate 83·1%, Calcium 0·01%, Iron 1 mg. per cent.

Arrow root is mainly starch.

Green Vegetables.

Leafy vegetables. They have very little caloric value. They are eaten to provide the body with :—

(1) *Vitamins.* Vitamin C and Carotene (Vitamin A.)

(2) Minerals Calcium and Iron.

(3) ***Rhouage.*** The frame-work of leaves is made up of cellulose which provides rhouage to the intestine and stimulate peristalsis.

Leafy vegetables are rich sources of calcium, iron and vitamin C, A and riboflavin. Turnip greens rank at the top in calcium content. 3 ounces of cocked green will supply approximately one third of the daily allowance. Cabbage greens and outer leaves of cabbage are even richer than turnip greens.

Calcium of broccoli of cauliflower and turnip greens is nearly as available as that of milk (Fincke and Speirs). The calcium of spinach and beet greens is not nutritionally available because of high oxalic content of these vegetables.

Iron.—3 ounces of cooked turnip green, mustard greens, spinach or beet greens will supply approximately 25% of the adult daily allowance.

Vitamin C.—6 ounces of shredded raw cabbage will supply nearly a third of the days' allowance of vitamin C. Waterercress, broccoli, turnip greens, mustard greens and Kale are similar in vitamin C content to cabbage.

Vitamin A.—Leafy vegetables are rich sources of carotene. Sherman gave a range of 13,000–27,000 units per hundred grams for Kale, spinach, turnip greens, and mustard greens.

Riboflavin.—Most of the leafy vegetables are excellent sources of riboflavin. 3 ounces of cooked beet greens will supply about one fourth of the daily adult allowance, spinach and Kale about one-fifth.

Roughage.—Leafy vegetables provide roughage in diet and are useful in atonic constipation.

Green Vegetables.

Agathi (*Agasti*)—Calcium 1·13%, Iron 3·9 mg.% Carotene 9000 units per 100 gms.

Amaranth, tender (*Lal Cholai*)—Calcium 0·50%, Iron 21·4 mg.%, Carotene 2,500—11,000 units, B_1 10 units, Vitamin C 173 mg. per 100 gms.

Bengal gram leaves (*Channa ka Sag*)—Calcium 0·34%, Iron 23·8 mg. per cent.

Cabbage (*Band Gobi*)—Calcium 0·03%, Iron 0·8 mg.%, Carotene 2000 units, Vitamin B_1 50 units, Vitamin C 124 mg. per 100 gms.

Celery (*Ajwan ka Patta*)—Calcium 0·23%, Iron 6·3 mg.%, Carotene 5800—7500 units, Vitamin C 62 mg. per 100 gms.

Coriander (*Hara Dhaniya*)—Calcium 0·14%, Iron 10·0 mg. %, Carotene 10460—12600 units, Vitamin C 135 units per 100 gms.

Curry Leaves (*Gandhela*)—Calcium 0·81%, Iron 3·1 mg. %, Carotene 12600 units, Vitamin C 4 mg. per 100 gms.

Drumstick (*Saijana*)—Calcium 0·44%, Iron 7·0 mg.%, Carotene 11,300 units, B_1 70 units, Vitamin C 220 mg. per 100 gms.

Fenugreek (*Methi*)—Calcium 0·47%, Iron 16·9mg.%, Carotene 3,900, Vitamin B_1 70 units per 100 gms.

Garden cress (*Halim*)—Calcium 0·36%, Iron 28·6 mg. %, Vitamin B 50 units per 100 gms.

Gogu (*Patwa*)—Calcium 0·18%, Iron 5·4 mg. %.

Khesari leaves—Calcium 0·16%, Iron 7·3 mg. %, Carotene 6,000 units per 100 gms.

Lettuce (*Salad*)—Calcium 0·32%, Iron 2·6 mg.%.

Mint (*Pudina*)—Calcium 0·20%, Iron 15·6 mg. % Carotene 2,700 units, per 100 gms.

Rape leaves (*Sarson ka Sag*)—Calcium 0·37%, Iron 12·5 mg.%.

Spinach—Calcium 0·06%, Iron 5·0 mg.%, Carotene 2600—3500 units per 100 gms., Vitamin B_1 70, Vitamin C 48 mg. per 100 gms.

Soga leaves—Calcium 0·18%, Iron 8·0 mg.%.

Green Vegetables.

(2) Other vegetables.

Amaranth stem (*Cholai ki dandi*)—Calcium 0·26%, Iron 1·8%, mg.%.

Arti choke (*Hattichak*)—Calcium 0·12%, Iron 2·3 mg.%, Carotene 60 units, Vitamin B_1 75 units per 100 gms.

Ashgourd (*Petha*)—Calcium 0·03%, Iron 0·5 mg.%, Vitamin B_1 21 units, Vitamin C_1 mg. per 100 gms.

Bittergourd (*Karela*)—Calcium 0·02%, Iron 2·2 mg.%, Carotene 210 units, B_1 24, Vitamin C 88 mg. per 100 gms.

Brinjal (*Baigan*)—Calcium 0·02%, Iron 1·3 mg.%, Carotene 5 units, B_1 15 units, Vitamin C 23 mg. per 100 gms.

Broad Beans (*Sem*)—Calcium 0·05%, Iron 1·6 mg.%, Vitamin C 12 mg. per 100 gms.

Calabash cucumber (*Ghia Kaddu*)—Calcium 0·02%, Iron 0·7 mg.%.

Cauliflower (*Gobi Phool*)—Calcium 0·03%, Iron 1·3 mg. %, Carotene 38 units, Vitamin B_1 110 units Vitamin C 66 mg. per 100 gms.

Cucumber (*Kakri, Khera*)—Calcium 0·01%, Iron 1·5 mg. %, Vitamin B_1 30 units, Vitamin C 7 mg. per 100 gms.

French beans (*Pharans bean*)—Calcium 0·05%, Iron 1·7 mg. %, Carotene 221 units, Vitamin B_1 26 units, Vitamin C 14 units per 100 gms.

Ladies fingers (*Bhindi*)—Calcium 0·09%, Iron 1·5 mg.%, Carotene 58 units, Vitamin B_1 21 units, Vitamin C 16 mg. per 100 gms.

Plaintain green (*Kela*)—Calcium 0·01%, Iron 0·6 mg. %, Carotene 50 units, Vitamin B_1 15 units, Vitamin C 24 mg. per 100 gms.

Pumpkin (*Kaddu*)—Calcium 0·01%, Iron 0·7 mg.%, Carotene 84 units, Vitamin B_1 200 units, Vitamin C 2 mg. per 100 gms.

Ridge gourd (*Torai*)—Calcium 0·04%, Iron 1·6 mg. %, Carotene 56 units, Vitamin B_1 22 units per 100 gms.

One medium sized sweet pepper will furnish 870 units of Vitamin A and 180—200 mg. of Vitamin C. Chili-pepper

are a good source of vitamin A. Fresh chili is an excellent source of vitamin A and iron & when fresh of vitamin C.

Fruits.

Fruits are eaten for their taste and flavour. The chief nutritive constituents in them are the carbohydrates mostly in the form of sugars, fructose and glucose. They contain good deal of cellulose, and pectin. Unripe fruits contain organic acids which cause irritation of the intestine. They are poor sources of minerals but are rich in vitamin C. The most important fruits are :—

(1) Citrous group. This goup is important for vitamin C.

(1) Lemon—Vitamin C 39 mg. per 100 gms. of juice.

(2) Lime (*Nimbu*)—Vitamin C 63 mg. per 100 gms. of juice.

(3) Organge (*Santra*) —68 mg. per 100 gms. of juice.

(4) Grape fruit (*Chakotra*) —31 mg. per 100 gms. of juice.

(5) Pomeloe—20 mg. per 100 gm. of juice.

(2) Raisins group.

(1) Black currants—Vitamin C 136 mg. per 100 gms.
Red currants— „ „ 50 mg. „ „ „
Raisins— very little.

(3) Strawberry group.

Strawberry (*Staberry*) —52 mg. per 100 gms.
Gooseberry (*Indian Amla*)—600 mg. per 100 gms.

Raspberry—30 mg. per 100 gms.

Miscellaneous.

Apple (*Seb*) From dietetics point of view it is a poor source of vitamins. As compared to its high price, the outturn in the shape of supply of vitamins is too poor to permit its use except for very rich. It is useful in diarrhoea due to its pectin content but even for this cheaper substitutes are available. The old proverb "one apple a day keeps the doctor away" is certainly wrong, doctor being used as synonym of disease. On account of its high cost we can safely say "one apple a day, brings in disease any day". The regular waste of money on this costly fruit is sure to lead to economy in other dietary essentials and thus lead to deficiency disease. It contains only 2 mg. vitamin C per 100 gms.

(2) Banana (*Kela*)—It is highly nourishing. It is a good source of carbohydrates chiefly in the form of sugar and dextrins, proteins and vitamins. It is useful in the treatment of diarrhoea and it is easily digested.

Composition :—Water 61·4%, Protein 1·3%, Fat 0·2%, Carbohydrate 36·4%, vitamin B_1 50 units vitamin C 1 mg. per 100 gms. Caloric value 43 C per ounce.

(3) Dates, poor source of vitamin, caloric value 80C per ounce.

(4) Figs are considered laxative, poor source of vitamins.

(5) *Grapes.*—The are also very poor in vitamin, vitamin C 3 mg. per 100 gms. caloric value 13C per ounce. How much money is really wasted on this fruit.

(6) Guava (*Amrud*)—Contains Vitamin C 299 mg. per 100 gms.

(7) Mango (*Am*)—It is rich in carotene and Vitamin C carotene 4800 units, vitamin C 13 mg. per 100 gms.

(8) Papayya ripe.—It is rich in carotene and vitamin C, carotene 2020 units vitamin C 46 mg. per 100 gms.

(9) Peaches (*Aru*) useless for vitamin.

(10) Pears (*Nak*)—useless for vitamin

(11) Pineapple (*Annas*)—rich in vitamin C 63 mg. per 100 gms.

(12) Pomegranate (*Anar*)—vitamin C 16 mg. per 100 gms.

(13) Tomatoes—carotene 1416 units vitamin C 15 mg. per 100 gms.

Condiments and spices. These stimulate appetite and digestive powers. They are not quite essential for a healthy man. In small quantities they do not harm and prove beneficial. They are necessary for invalids, convalescents and persons of weak appetite. They are harmful in gastritis and gastric ulcer. Excessive use is very dangerous. To this class belong mustard, pepper, ginger, vinegar, cinnamon, cloves nutmeg etc.

CHAPTER XII

Beverages

Aerated waters.—Artificial aerated waters are waters charged with carbonic acid gas. They have sharp pleasant taste. Carbonic acid gas acts as a stimulant to the gastric movements and gastric secretion.

Carbonic acid gas is rapidly absorbed from the stomach into the blood and aerated waters may prove harmful in cases in which blood has already got an excess of carbonic acid gas as in cyanosis. In dilated stomach the gas acts as harmful by dilating this organs still further. The action of a weakened heart may be hampered by the distended stomach.

Natural and artificial mineral waters. Natural mineral waters are obtained from natural springs. They contain various inorganic salts but mostly salts of sodium and calcium. Most of them contain carbonic acid gas also which is present in a much more stable form than that present in artificial mineral waters. The specific effects are due to the inorganic salts and the carbonic acid gas.

Artificial mineral waters.—These are made by dissolving the inorganic salts in distilled water in the same proportion as found in natural mineral water intended to be imitated. These are inferior to natural mineral waters inspite of the identical composition.

Tea. Tea is generally of two kinds:—

1. Black 2. Green

1. Black Tea is fermented and during fermentation some tanin is oxidised. Therefore it contains lesser tanin than the other variety.

2. Green Tea. This is not fermented and therefore contains more tanin than the black variety.

The effects of tea are due to caffeine and tanin. The flavour is due to volatile oils.

Composition (Hosai)

	Green Tea	Black Tea
Caffeine	3·20 per cent	3·30 per cent
Tanin	10·64 „ „	4·89 „ „

Tea making.—The proper way of making tea is by infusion. Boiling water is poured on the leaves and allowed to stand for five minutes. The proportion of dried leaves to water is roughly 1 teaspoonful of tea to 7 ounces of water. The caffeine comes out much more quickly than tanin and this infusion takes out practically whole of caffeine and about two thirds of tanin. An ordinary tea cupful will contain about 3·5 grains caffeine.

Tea prepared by the process of boiling contains large amount of tanin as well as caffeine and is apt to prove harmful. It is rather astringent.

Addition of milk or cream to tea lessens astringent effect of tanins.

The so-called second brew contains practically very little caffeine and a large amount of tanin and so it is harmful.

Coffee.—It contains about 1·28—1·3 per cent caffeine. An ordinary teacupful contains about 1·7 grains of caffeine and 3·24 grains of tanin (Hutchison).

Cocoa.—Cocoa contains an active principle closely related to caffeine. It is known as Theobromine and is present to the extent of about I—2 per cent. It contains some tanin and starch and fat also.

The effects of tea and coffee are due to caffeine. Caffeine is a stimulant of the nervous system especially the higher "Psychic" centres. So it clears the mind, abolishes the sense of fatigue and wards off sleep.

It stimulate the respiratory and cardiac centres as well.

It acts as diuretic by its direct action on the kidneys. It stimulates the capacity for muscular work. It is neither habit forming nor cumulative. Tanin impairs digestion. If the tea is properly prepared its harmful effects are practically negligible in a healthy person. In gastric disorders such as gastritis, gastric ulcer, doudenal ulcer tea provcs harmful due to tanin. In excitable persons the stimulant action of tea and coffee is undersirable. Excessive indulgence may produce symptoms referable to the nervous system or digestive system. The nervous system becomes excitable and the person may suffer from nervousness, tremulousness, palpitation, loss of sleep, giddiness and depression.

On the digestive system the effects are due to tanin (locally) as well as due to caffeine through nervous system. The patient suffers from flatulance, atonic dyspepsia and feeling of sinking. Cardiac action also becomes disturbed.

The excessive use of caffeine containing beverages may contribute to the pathogensis of "peptic" ulcer in the ulcer susceptible individual, may aggravate an already existing ulcer and may render treatment more difficult. Contrary to the earlier observations caffeine has been found to have a definite stimulating effect on gastric secretion in man. The peak of the response to the intramuscular administration of caffeine usually does not occur until sixty to seventy minutes after the injection, whereas, when caffeine is given as a test meal the peak response occurs in from 30—40 minutes.

J. A. Roth studied the gastric secretory response to a "Caffeine test meal" in 50 asymptomatic medical students and nurses and in 36 patients undergoing management for "peptic" ulcer. The results were :—

(I) Response of Normal Subjects—75 per cent showed an abrupt, transient stimulation with a peak followed by a return to the control level within sixty to seventy minutes. In 15 per cent a low flat curve was obtained which

returned to the control level in 70—80 minutes. 10 per cent showed a prolonged secretory response. Out of these 5 cases (10 per cent) 3 have developed symptoms of ulcer and one showed ulcer on x-ray examination.

(2) 36 ulcer patients with the exception of 1, have consistently shown a prolonged response to the caffeine test meal.

Alcohol stimulates gastric secretion and its use is interdicted in ulcer patient. Alcohol works synergistically with histamine and so does caffeine. Next J. A. Roth studied the effect of caffeine containing beverages like coffee, coffee with sugar, tea coffee with sugar and cream. All these preparations simulated the gastric secretion. Cream showed some buffering action.

The authors reached the conclusion that the consumption of caffeine containing beverages should be restricted to a minimum in ulcer cases and if small amounts are allowed, they should be taken with cream and sugar. Coffee contains other secretagogues beside caffeine also. Excessive use of caffeine containing beverages may contribute to the pathogenesis of "peptic" ulcer in susceptible individual.

Now it has been found that use of tea and coffee may not be forbidden to gouty patients. The methylpurines

contained in tea and coffee do not increase uric acid output.

Cocoa.—The action is like tea and coffee but much weaker. Though it contains nutritive elements—starch and fat but in the beverage the amount of these elements present is almost negligible.

Alcohol and Alcoholic Drinks

Action of alcohol.—Alcohol acts as a chemical irritant to mucous surfaces. A strong alcoholic drink like whisky or brandy causes a sensation of burning in mouth, the mucous membrane becomes somewhat corrugated and whitened. Repeated use of strong beverages leads to catarrh of the pharynx and stomach. The irritation in the mouth causes a reflex flow of Saliva. In the stomach it increases the flow of gastric juice, but this juice is almost devoid of pepsin though normal in the amount of hydrochloric acid. Stronger and repeated dose only increase the mucus in the gastric juice and decrease the amount of hydrochloric acid. Alcohol acts as a carminative like many other volatile substances. Weak concentrations of alcohol 1—2% have little effect on the activity of pepsin but higher concentrations may retard the activity of pepsin considerably. Alocohol is very

rapidly absorbed through the wall of the stomach and the small intestine. It is burnt in the body and can act as a food. The rate of combustion is rather slow about 7 c.c. of absolute alcohol per hour. Its rapid absorption from the gastro-intestinal tract makes it a rapidly available fuel material in emergencies, Absorption of alcohol from the stomach is retarded by the presence of food especially fats. On the nervous system it acts as a depressant. Alcohol is a narcotic.

It has no direct effect on the respiratory or cardiac systems. It reflexly stimulates the heart. It causes dilatation of the blood-vessels of the skin and increases the loss of heat from the body. It does not raise the body temperature, but causes a person to feel warmer on account of the dilatation of the blood vessels of the of the skin which proves harmful in cold weather.

Alcohol should have little or no place in dietetics. Its use in medical practice has rapidly decreased.

Alcoholic drinks may be divided into :

(1) Spirits

(2) Malt Liquors

(3) Wines

Beverages

(I) Spirits are products of distillation and therefore have high alcoholic content. Examples are Gin, Whisky, Brandy and Rum. The average percentage of alcohol by volume in spirits varies from 37-43%. They are too highly alcoholic for ordinary dietetic use unless used in small quantity and diluted freely.

(2) Malt Liquors include beer or ale and port or stout. The most important constituents of these beverges are alcohol, dextrins, sugar, and a small amount of nitrogen 'extracts' and organic acids. The percentage of alcohol varies from 3·3%-8·43%. Malt liquors contain digestible carbohydrates and so they must be rated as foods. A glass of good beer has got a caloric value of about 168C. Malt liquors are especially prone to produce obesity and predispose to gout. In inflammation of the genito-urinary tract they prove harmful. The carbohydrate content makes them unsuitable for diabetics.

(3) *Wines.*—Wine is a drink produced from the pure juice of the grape by fermentation. The natural wines do not contain more than

16 per cent of absolute alcohol by volume as the process of fermentation stops naturally at this concentration of alcohol.

Fortified wines are those in which the process of fermentation has been artificially arrested by the addition of alcohol or some concentrated alcoholic preparation such as spirit, brandy etc.

Composition of wines:

1. *Alcohol.*—The maximum percentage of absolute alcohol in natural wines is 16%. In fortified wines it is much higher according to the quantity of alcoholic preparation added afterwards.
2. *Acids.*—Organic acids like tartaric, malic and lactic. The total acidity is about 0.3-0.7 per cent.
3. *Volatile oils.*—These give flavour to the wine.
4. *Sugar.*—In natural wines it is about $\frac{1}{2}$%, in fortified wines about 2%.
5. *Esters.*
6. *Extractives.*
7. *Glycerol.*
8. *Tanin.*—In some wines it may be as much as 7-10 per cent.

9. *Iron and inorganic salts.*—Iron may be present as much as 2·5 milligramms per 100 c.c. in some wines.

10. *Vitamins.*—Some wines contain large amounts of vitamin B_1.

Wines are weak alcoholic preparations.—Their effects depend on the amount of alcohol contained. Their use as a regular object of dietary is to be avoided. The actual food value is little but use in moderation may be harmless. They should not be taken on empty stomach. B_1 content is useful in protecting against deficiency of vitamin B_1.

CHAPTER XIII.

Nutritive value of Processed Foods.

In the civilised world of to-day many foodstuffs are subjected to various processes for preserving and preparing them. This leads to the destruction of valuable nutrients to a great extent. A brief survey of the effects of different processes on nutritive value of food stuffs is given below:—

I. *Cold storage.*—Vitamin C. Loss of vitamin C in cold storage depends on the following factors:—

(*a*) *Length of time.*—Greater the time of cold storage, greater the loss.

(*b*) *Degree of temperature.*—Higher the temperature, greater the loss.

(*c*) *Access to oxygen.*—Greater the access to oxygen, greater the loss.

Eheart reported an average loss of 20% of the vitamin C content of apples during 12 weeks of storage at temperatures ranging from 35.3-37.9F.

After 18-24 weeks the loss was 33%. If previous to storage the oxygen inside the apple is allowed to be consumed by submerging them in a 2.5% salt solution for 16-24 hours at room temperature or for one hour at

120F, storage can be done without measurable loss of vitamin C.

Potatoes stored at 15·5c lost 30% vitamin C in one month, and 20% at 4.5 C stored for 9 months.

Spinach stored at from 1-3 C lost its vitamin C very slowly, whereas at room temperature it lost half in 3 days and nearly all in 7 days.

Green peas showed no appreciable loss of vitamin C in six days at 1-9 C but considerable at 18-22 C (Maek etal). Other vegetables lost vitamin C in varying proportions from 30-60%. Canned citrus fruits and tomatoe juice after the can is opened lost no vitamin C in 48 hours, stored in a refrigerator.

2. *Frozen foods.*–Vegetables should be frozen quickly and thawed quickly in order to prevent loss of vitamin C. Frozen vegetables must be cooked quickly after they are thawed. Vitamin C content of frozen peas fell from 13.1 mg per 100 g to 4.1 mg after they had been defrosted from 2-6 hours (Feller and Stepat).

3. *Cooking.*—Heating does not destroy vitamin C if oxygen can be excluded. Heating of peas from 25-50 minutes at 250F had little effect on destruction of vitamin C

provided oxygen was excluded. Slow cooking is more destructive to vitamin C than rapid cooking. Loss of vitamin C in cooking becomes progressively greater with the following methods :–steaming, boiling, baking and pressure cooking; but in no case did it exceed 25%. Cooking water extracted a large amount of water soluble vitamins and as little water should be used in cooking as possible if it is to be thrown away. Cooking water extracted vitamin C from 50%-66%. Boiling vegetables in their skins prevented some loss of water soluble vitamins.

Other vitamins.—All the vitamin A, and from 7-075% of the vitamin B_1 is retained in vegetables on boiling (Oliver). Aughey and Daniel report that there was no loss of thiamine in presure cooking or boiling carrots; 16% loss in baking potatoes; 20% in pared and boiled potatoes; 22% in boiled spinach; 9% in simmered green peas, and 22% if soda is added; 18% in boiled beans and 59% if soda is added; no loss in boiled navy beans; no loss in rolled oats or wheat cooked in a double boiler; 14% loss in baking bread; 15% in braised pork loin and 43% loss in roast pork. Nicotinic acid and riboflavin are stable to most cooking processes. Addition of soda to flour and grains for cooking destroys vitamin B.

Cooking of certain food makes it more hygienic by

destroying the micro organisms, it improves the taste and makes them more digestible.

4. *Blanching.*—In blanching, the vegetables loose considerable amount of sodium, potassium and magnesium which are of no dietetic importance. Calcium content increases as it is absorbed by the vegetables from the hard water used for blanching; vitamin B_1 and C are also lost depending upon the length of time of blanching and the degree of temperature.

5. *Canning.*—In this process heat varying from 240F-250F is applied to destroy spoilage organisms. This process does not destroy vitamin A but B_1 is destroyed to some extent. The loss of vitamin B_1 varied from 60-80%. Vitamin C is not destroyed in canning if oxygen is removed before hand. Cooking makes vitamin A, protein and some minerals more easily available to the man. Containers from which all the oxygen is removed are better for canning.

6. *Dehydration.*—It almost completely destroys Vitamin C of most dehydrated products. Sulfuring of fruits has a preservative effect on their vitamin C but destructive effect on vitamin B.

7. Baking of bread results in a loss of from 5—9%

of the thiamine content. Toasting causes another loss, ranging from 12-24%.

8. *Hydrogenation of fats.*—It is said to lower the digestive co-efficient (Sherman).

9. Fermentation as occurs in making of sauerkraut, in pickling or in wine making has no destructive action on vitamins.

10. *Milling of cereals.*—There is great loss of vitamin and minerals.

CHAPTER XIV.

Foreign and Indian Dietaries.

English Diets (a) Bread.—Bread is made from wheat flour because wheat contains a protein, gluten which has the property of becoming viscid when mixed with water. Wheat flour two parts, water one part and active yeast in sufficient quantity (about 2 dr. in 1 lb. of dough) are mixed together, kneaded and made in to dough. The dough is kept at 65°-68°F for about 1-1½ hours and allowed to 'rise'. The dough is blown up with bubbles of gas liberated by the action of yeast on flour. The viscidity of dough is sufficient to make it remain in the form of a sponge or honeycomb, instead of collapsing again, as it otherwise would do, and allow the gas to escape. The flour of cereals which do not contain protein like gluten can not be made viscid and so are not used for making bread. The dough is now put in loaf tins and placed in an oven for 1½ hours at a temperature of about 450°F. Heat causes the gas in the dough to expand and blow the dough up so that it becomes spongy and full of little cavities. The outer portion of the loaf becomes hard and reddish brown and is called crust. This is made up of coagulated proteins, starch and dextrin.

Raising of dough may also be accomplished by the use

of baking powders but baking powders destroy vitamin B_1 in the flour.

Composition of bread.—The composition differs according to the quality of the bread. Percentage composition.

White bread	Protein	Carbohydrate	Fat
	8·5-9·5	54·6	1·06
Brown bread	5-6·34	50·2	1·06
Whole meal bread	6·3	44·8	1·2

Caloric value 270-300 C per 100 gms.

Bread is taken in the form of toast or sandwiches.

Toast.—Bread is cut it to slices breadthwise. These slices are roasted on a hot metal pan till they become brown. The bread becomes hard and dry easy to chew with teeth.

Sandwiches.—The bread is cut into slices breadth wise when making a small quantity, otherwise lengthwise. Spread slices of bread thinly with butter and half the slices with filling. Filling may be made of chopped meat, chopped chicken, or vegetables like asparagus or cress. Pair and press down softly and remove the crusts. Cut into different shapes. Rolls and bread sticks are different forms of bread in differenr shapes.

Biscuits are made from fine flour with or without sugar, butter, milk etc. They contain very little water 5% or so.

Cake.—To 3 parts of dough as prepared for bread are added butter or lard 1 part, sugar ½ part, some salt, spices and currants. All are mixed well. This is put in a well buttered loaf-tin and covered and allowed to 'rise' for 30 minutes. Afterwards it is baked in an oven at 350°F for 1¼ hours. This is the commonest way for preparing cakes and there are many different recipes for different varieties.

Muffins, Scones and Waflles are different varieties of cake.

Porridge or gruel may be prepared from oatmeal, rolled oats, any wheat preparation, corn meal or any other cereal.

Take 4 ounces of corn meal. Mix with 4 ounces of water. Boil one pint of water and add one teaspoonful of salt. Add the corn meal mixed with water gradually and keep stirring constantly to prevent lumping, cover and cook for twenty minutes. Serve with cream or milk.

Instead of water milk may be used to cook in the cereal. This becomes much more nourishing.

$\frac{1}{2}$ cup of any kind of cooked cereal may be thinned to desired consistency with milk and served with $\frac{1}{4}$ cup of cream and with sugar if desired.

Pudding.—Pudding is made from milk and some cereal like rice, semolina, wheat flour, slices of bread ete.

Flour Pudding.—Take 4 ounces of flour mix with one cup of water and mix it in 1-2 pints of boiling milk. Cook gently for 10-15 minutes stirring all the time. Add sugar to taste.

Rice pudding.—5 ounces of rice are added to 2 pints of boiling milk and cooked for 30 minutes. Add sugar.

Jelly.—Jellies are prepared from gelatine. About 1 ounce of gelatine is dissolved in one pint of boiling water. Sugar and other things are added to taste.

Soup.—Take 1 lb. of meat and boil in 43 lbs. of water. Scum is removed and it is allowed to simmer for 2½ hours, skimming occasionally. Meat is removed—the clear liquid is soup. This is called clear soup.

Vegetable Soup.—Vegetable soup is prepared like meat soup using any single vegetable or mixture of vegetables as substitute for meat. Salt and condiments may be added to taste. More commonly the soup is used as

vehicle for other articles of diet like butter, cream or flour and in such cases the caloric value of soup will depend on the amount of fat, and carbohydrates added.

Cream Soup.—Take $\frac{1}{4}$ cup strained vegetables or canned tomato, pea, spinach or asparagus soup. Add $\frac{1}{2}$ cup Cream.

Purees.—Vegetables are cooked and passed through a wire sieve. Milk and flour may be mixed to make a paste and may be cooked. Butter or cream may be added to purees.

Salads.—are of two kinds:—

(1) Cooked Salads. (2) Raw Salads.

(1) *Cooked Salads.*—Vegetables are shreded and cooked. It may be dressed with salad dressing. To cooked and shreded vegetables, flaked and cooked fish or meat cut into dice and cooked may be added. Then they are dressed with salad dressing.

(2) *Raw Salads.*—These are prepared from leafy vegetables mostly but carrot and tomato may also be used. Raw salads are taken mostly for vitamin C. The vegetables are chopped or shreded. Onion or garlic may be added and salad dressing is given.

Salad dressing.—To two parts of salad oil one part

of lemon juice or vinegar is added. Then salt, mustard and pepper are added and all are mixed well.

Gravy.—One ounce of meat essence (left in baking tin after fat is drained off) is added to one pint of boiling water. Add pepper and salt to taste. Some time half an ounce flour is added and cooked. Butter may also be added or stewed and seeved tomatoes also.

Sauce.—Sauce is prepared from flour, butter, water, milk and condiments. About 2 ounce of butter is heated in a saucepan and then 1 ounce of flour is added. The mixture is cooked till it bubbles. Gradually ½ pint of water or milk is added and cooked. Then pepper and salt are added to taste. Sweet sauce may be prepared by adding sugar. Custard sauce is prepared from 1½ cups of milk, 2 egg yolks, 1 oz. sugar and essence. Milk is boiled and the mixture of sugar and eggs added with constant stirring. Cook till the mixture becomes thick. Then add essence.

Hard sauce.—½ cup of butter is mixed with 2 cups of powdered sugar and gradually added to by 3 teaspoonfull of boiling water. Beat well.

Eggs

Plain omelet.—Blend the whites and yolks of eggs

by beating for moment or two. Place butter in a hot omelet pan. When butter is melted add egg mixture and spread evenly. Fry quickly over a hot flame or fire for a moment or two, till set underneath. Keep lifting up the sides with a knife. When browned on the bottom and puffed, fold over and serve.

2. *Scrambled eggs.*—Mix one egg contents in about half an ounce of milk. Heat together one ounce of butter and half an ounce of milk. When the butter is melted, stir in the egg mixture and cook, stirring constantly till set. Put salt and pepper to taste.

3. *Steamed eggs.*—A cup is buttered. Contents of one egg or more eggs are added and the cup is put in the steamer and covered. It is steamed for about two minutes after which it becomes set.

4. *Boiled eggs.*—Eggs are boiled in their shell. Place eggs in a saucepan. Cover with cold water. Bring to the boil and continue boiling for 10 minutes. Remove to a basin of cold water and shell at once. This is hard boiled eggs. Half boiled egg is egg boiled for 4 minutes.

5. *Eggnog.*—6 eggs; 4 tablespoons sugar; 6 cups milk. Beat eggs. Add sugar. Add milk. Beat mixture

well. Chocolate syrup or vanilla may be added if desired. Makes 4 servings.

Fish

(1) *Baked fish.*—Take whole small fish or thick streaks of large fish. Clean and wipe dry. Place in a buttered pan. Sprinkle with flour, pepper and salt, and a few drops of lemon juice. Bake in an oven at 350°-375°F for 10 minutes or so until the fish shows signs of separating from the bones. Moisten every ten minutes with melted butter or any fat. Cook till it gets brown.

(2) *Boiled fish.*—Take whole small fish or thick streaks of large fish. Clean it. Wrap the fish in a piece of cloth and put it in kettle. Add boiling water, just enough to cover the fish with a little salt and vinegar. Bring to simmering point and allow to simmer till the fish is curdled looking or shows signs of separating from the bones. Drain well and serve.

(3) *Steamed fish.*—Place the fish above the water on a rack in kettle or use a steamer.

(4) *Fried fish.*—Have enough fat melted in the pan to keep the fish from sticking to the pan. Cook till it becomes brown on the bottom side then tuın over and cook similarly. The other method is:—boil about one

pound of clarified fat in a saucepan at a temperature of 370°F. Lower gently into the boiling fat two small fish at a time and fry for 5 minutes or until golden in colour. Then take them out and drain on kitchen paper.

Meats.

(1) *Boiled meats.*—Wipe the meat. Place in a saucepan. Cover with boiling water. Put on a lid. Boil hard for 5-10 minutes. Add salt to taste. Boil and remove the scum from time to time add boiling water as required. Meat must always be covered with water.

(2) *Stewed meat.*—This is the ideal method of cooking meat. Meat is first fried till it is brown on both the sides. Then it is put in hot water, salt and condiments are added and the whole is cooked slowly so that the temperature of water in which meat is placed does not rise above 180°F.

(3) *Roasted meat.*—Wipe and rub the meat with flour and condiments.—Place in a baking tin and spread with fat. Roast in hot oven at about 500°F for 15 minutes to seal in the juices, then reduce the temperature to 350°F-400°F and cook till tender.

(4) *Baked meat.*—It is like roasted meat. The heat is applied all round the meat at once.

(5) *Grilled meat.*—It is a form of roasted meat.

Sour milk cheese.—Take sour milk or *Dahi.* Heat it slowly till the whey rises. Pour it off. Place the curd in a muslin bag. Stand in a strainer and leave to drain for 5-6 hours. Stir in the cream, season to taste with salt or sugar. *Dāhi* may be strained without preliminary heating.

Toffee.—It contains melted sugar and butter in almost equal proportions.

Chocolate.—It contains about 45 per cent of cane sugar.

Jams.—These are fruits preserved in a strong solution of sugar.

Marmalade.—The sugar solution is weaker than in jams.

Pickles.—Dissolve 1 lb. of salt in 1 gallon of water boil and strain allow to stand for four days. Drain thoroughly. Put the vegetables in glass jars add spices and fill with vinegar.

Beverages.

(1) *Fruitades.*—For an example lemonade may be taken. Halve the lemons and squeeze out the juice. Strain

the juice into a jug, and add sugar and water. Mix. Add ice to taste.

In hot weather sugar may be replaced by a little quantity of table salt. The salt will replace the salt lost in perspiration.

(2) *Fruit punch.*—Simple Syrup and fruit juice are mixed together. Add aerated water and serve at once.

(3) *Fruit Syrups.*—Simple Syrup is first prepared. Strained fruit juice is added to it.

(4) *Fruit Cocktail.*—Fruit juice is taken. Dissolve sugar and allow to stand overnight to ripen before using. Add any sweet alcoholic drink to taste.

(5) Fruit Fools. Fruit pulp is added gradually into the whipped cream or custard sauce. Chill it. Cooked fruit pulp may also be used.

(6) *Fruit Juice with Egg.*—Beat 1 egg well. Add 1 cup fruit juice, add sugar as desired.

Almond Milk.—Soak almonds for some time in water or scald them to remove the skin. Ground in pestle and mortar. Add a glassful of cold water gradually to every 30 almonds whilst stirring all the time. Cream or milk may be added to it.

(1) *Roti or Chappati.*—A typical common type of *chappati* is made from wheat flour. To about 1 lb. or half a seer of wheat flour $\frac{1}{3}$—$\frac{1}{2}$ parts of water is added and mixed till it is changed into dough. This is kneaded well with hands to make it uniform in consistency. A little salt is also added to the dough. Dough may be kept for $\frac{1}{2}$-1 hour before making into *chappatis.* Small balls of dough are made depending upon the size of the *chappatis* required. Each ball is rolled in to circular shapes of *chappatis* or cakes with the help of a hand roller on a circular platform (*Chakla Belan*). The *chappati* is cooked on a heated iron pan and red burning charcoal. During cooking, the air in the dough gets expanded and raises the dough in to one layer called crust. This is much more marked if *chappati* is small and then it is called *phulka.* Gluten of wheat flour is responsible for allowing one layer of *chappati* to become expanded.

Baisini roti.—A little gram flour is (Baisan) added to the dough to prepare *baisni roti. Baisini roti* is a little easier to digest as gastric juice can penetrate more easily than in pure wheat flour *chappati* and it contains higher content of protein.

Similarly *chappati* or *roti* may be made from any other kind of flour but as other cereals do not contain

glutean, you can not make *phoolka* out of them. In villages mostly the *roti* of *bajra*, or maize is eaten.

Khamiri Roti.—About ½ oz. yeast is added to 1 lb. of flour and made to dough which is allowed to ferment for some time. The *chappati* made in this way is spongy and more easily digested.

Use of Soda bicarb in Chappatis.—Some people put a little Soda Bicarb in the dough. This increases the raising quality of dough by the liberation of carbon dioxide on heating. The *chappatis* become crisp but vitamin B_1 in dough is destroyed and so the use of Soda Bicarb is not to be recommended.

Pratha.—*Pratha* is prepared from wheat dough. A little ball of dough is taken and made into small circular shape. A little ghee is applied over it and the ends are folded over. This is now rolled on *chakla* in a square shape and cooked on heated iron pan with the help of ghee.

Puri.—*Puri* is prepared from wheat flour dough rolled into small circular shapes called *puri*. In a deep pan ghee is boiled and the *puri* gently lowered into it. It is allowed to be cooked till it becomes brown, now it is taken out.

Dal.

Chappatis are eaten along with the *Dal* or cooked vegetables.

Dal.—Mung ki Dal may be taken as a typical *Dal.* About 4 oz. of *Dal* is allowed to soak in water for about 2-3 hours. Then it is washed repeatedly and outer covering is removed. A little ghee or oil is put in a pot and heated over fire. When it boils *Dal* mixed with condiment and salt is fried in it and more water added. The whole is cooked over slow fire, stirring from time to time. About 12-16 ounces of water is added. The *dal* gets cooked in about ½-1 hour. The amount of water added depends on the consistency of the cooked *dal* required.

Other *dals* are prepared in a similar way. *Urd ki Dal* take longest time for cooking and soaking. The *dal* may be simply soaked and may not be washed repeatedly to remove the outer covering. Such *dal* is richer in vitamins and proteins and minerals.

Vegetables.

Vegetables are washed, cut into small pieces. Oil or Ghee is heated in a pot when it begins to boil. Vegetables mixed with condiments are fried in it. Then sufficient quantity of water is added and cooked on slow fire. It is

stirred occasionally. When they become tender remove from fire.

Curry (Kurhi)

Gram flour (Baisan) is taken and mixed with curds and water and condiments to the consistency of a cream. Ghee or oil is heated in a pot and when it begins to boil the creamy mixture is fried. Sufficient water is added, which depends on the consistency of the cooked product required. It is cooked on slow fire and stirred occasionally.

Bhat.

Bhat is commonly understood to mean cooked rice. But cooked whole cereals are also called 'Bhat' such as cooked Bajra, wheat, Indian Corn etc.

Raita.

Vegetables are cut into small pieces and boiled in water. The water is expressed out of the boiled vegetables. Then it is mixed with sufficient amount of curds, enough salt and condiments are added to taste.

Rice.

One pound of rice is taken. It is washed several times in water. Then 2 lbs. of water is added and cooked over slow fire. When rice becomes tender, it is put in a

sieve or cloth so that water is drained off. Repeated washing of rice causes loss of vitamin B_1. It should be washed as little as possible. Rice should be boiled in as little a water as possible which may be absorbed in the rice and is not to be thrown away. Rice water contains vitamins, minerals and soluble proteins and starch. Such rice from which rice water is not drained away; called *mandmar chawal.* It is much more nourishing than rice from which rice water is drained off.

Khichri.

2 parts of Rice and 1 part of *Mung ki dal* are taken. Sufficient amount of water is added to *Dal* and cooked over slow fire. Rice is soaked in water, when *Dal* becomes half cooked rice is added and cooked. Bajra Khichri is made from Bajra soaked in water for some time and pounded well. It is cooked in the same way as above.

Rabri.—In Southern Punjab, and Rajputana a commonly used preparation is called *Rabri*. It is prepared from bajra flour. About 1 ounce of bajra flour is mixed with 16-20 ounces of water and a little curd or lassi is added to it. It is allowed to rest for some time 4—6 hours in a warm place. Lactic acid bacilli fermentation goes on. Then it is cooked. It is served hot the same

evening or served cold the next morning. It is eaten as such or mixed with *lassi*. It is easily digestible and is a useful dish for invalids and convalescents.

Dalia.

Dalia may be prepared from wheat, barley or *bajra*. The cereals are soaked in a little water and pounded into small pieces. Then it is dried in the sun and again pounded and cooked mixed with water. The quantity of water added depends on the consistency of the product desired.

Roasted cereals are also used in preparing *dalia*. The roasted cereals are pounded into small pieces and cooked with water.

Khir Milk is boiled. To one pound of milk 1-2 ounces of rice washed in water are added and it is boiled till rice gets tender. 4 oz. sugar is added while still hot and allowed to cool. Raisins, Almonds or other dry fruits may be added.

Halwa.

Halwa is commonly prepared from *sooji*. Equal parts of *sooji* and *ghee* are taken. *Sooji* is fried in *ghee* till it becomes brown Now Sugar one and a half times of *sooji* is taken and dissolved in hot water in quantity about 2-3 times the weight of sugar. The sugar solution is gradually added to fried *sooji* and heated and kept constantly stirred till it is cooked

Mung ki dal, baisan and, other kinds of flours are also used to prepare *Halwa.*

Harira.

Take 1 ounce wheat flour and roast it in a little *ghee.* Then put 1½-2 cups of hot water and cook. Put sugar to taste. May put milk also instead of water for cooking.

Phirni.

One pound of milk is taken and about ½-1 oz. of rice flour is added to it. The whole is mixed well and cooked on slow fire, stirring all the time so that lumps do not form. When cooked 2 oz. sugar is added to it and mixed well.

Whey.

½ seer milk, is boiled and when still hot put juice of 1 lime to separate the casein. The clear liquid is whey.

Albumin Water.

One egg white is dissolved in 8 ounces of water.

Egg & Milk.

1 Egg+sugar+¼ seer milk. yellow and white of egg is stirred in milk.

Egg Jelly.

Boil 1 seer water. Remove it from fire and put in it contents of two eggs. Stir well.

Half Boiled Egg.

Boil water and put eggs and boil for 3-4 minutes. Then take them out.

Poached Egg.

Take small quantity of boiling water. Put egg contents. After few minutes egg white will become solidified. Remove it from water.

Egg Flip.

Fresh egg is broken in a cup and the white and yellow are mixed together. Then 1 cup of boiled warm milk is added and sugar is added and mixed.

Custard.

Milk 6 oz. egg 1 sugar 1 teaspoon

Mix and put in hot water.

Sago.

Sago 2 ounces, milk ½ seer. sugar 4 ounces. Cook sago first in water then in milk and go on stirring.

Arrowroot.

Mix in milk and boil at slow fire.

Sattu.

Is generally taken in hot weather. It may be prepared from wheat, barley or rice. The cereal is roasted and

then ground into flour. It is dissolved in water and a little sugar is added.

Chabina.

Chabina is a good dietary supplement for healthy persons. Gram, dried peas, Indian Corn, Bajra, Juwar, Barley or rice are taken. These are roasted with heated sand. Sand is removed. The cereal is eaten without salt and pepper or with a little salt, pepper and ghee which are added and mixed.

Chutneys.

Household *Chutneys* are generally prepared fresh and eaten within twenty four hours. Condiments and salts are ground together with the help of water with leafy vegetables like green leaves of coriander, mint, green mangoes, green imli, onion etc. till the consistency is cream like. *Chutneys* are eaten with *chappatis* , cooked rice, *dalia* or *Khichri.* Indian *chutneys* are very good substitute for raw salad dressing for sandwiches and are rich source of vitamins A and C.

Murrabbas.

Murrabbas are fruits boiled in strong solution of sugar and preserved in it. The food value depends upon the the amount of sugar eaten with them. All the vitamins

are destroyed. *Amla ka murrabba* is regarded a popular tonic, and some expect fairly good quantity of vitamin C in it as *amla* is very rich in vitamin C. The author tested *Amla ka murrabba* for vitamin C. and found it absolutely devoid of the vitamin.

Achars.

Judiciously used Indian *Achars* can be valuable sources of vitamin A and C in the diet. There are many ways of preparing *Achars* and there are a great varietis of them. The methods may be divided into two main methods :—

(1) In which the vegetables from which *Achar* is to be prepared are boiled.

(2) In which the vegetables from which *Achar* is to be prepared are not boiled.

(1) The process of boiling helps *Achar* to be ready in a shorter period. *Achar* is soft and keeps longer but there is practically cent per cent loss of vitamin C and a great loss of vitamin A. This method is to be recommended only in special cases.

(2) The method in which the vegetables from which *Achar* is to be prepared are not boiled. There is little loss

of vitamins but *Achar* takes a longer time to be ready *and is not soft.*

Some common forms of *Achars* are described :—

(1) *Nibu ka Achar.*—Raw lime (nibu) are cut into four pieces, smeared with salt or salt and pepper and are placed in a jar. Then limes are squeezed into it till the juice covers the pieces of lime. The jar is stirred from time to time and kept covered. This is a valuable source of vitamin C.

(2) *Mirch ka Achar.*—Green chillies are taken. It is better to select those which are not very pungent. They are cut into halves and filled in with salt or condiments. Put in a non-metallic pot and cover with juice of raw limes. It is stirred from time to time. *Mirch ka Achar* is a very good source of vitamin C as lime and *mirch* are both rich sources. So far pungent chillies should be avoided. The other way of preparing this *Achar* is to boil the green chillies. Mixed with salt, oil and powdered condiments. Vitamin C is lost in this way.

(3) *Mango Achar.*—Green mangoes are taken cut into small bits. They are mixed with rape seed oil and condiments consisting of salt, anise, fenugreek, cumin etc.

It is stirred daily and kept covered. This *achar* is a good source of vitamins A and C.

(4) Some vegetables are taken raw such as carrots, radish, cauliflower, gobi, etc. It is always good to prepare their *Achar* without boiling them. These vegetables are cut into small pieces, Mustard powder, salt, pepper, or any other condiment is added and allowed to rest for few days before use, stirring now and then. Some of the vitamins are preserved in these *achars*.

Tamarind Water.

Ripe tamarinds are washed with water and soaked in water for 4—5 hours. The stones are removed. The pulp dissolves in water. This is taken with *chappatis*, rice, *dalya*, *khīchri*, etc. Sugar or salt may be added to taste.

South Indian Diets.

(1) *Rice.*—Rice is washed and boiled, the boiled rice along with water is put into a seive or cloth in order to separate rice and the rice water. The rice water or the so called *conjee* is thrown away. Rice is taken with curry which is prepared in two ways :—

(I) *Vegetable curry.*—The vegetable is peeled and cut into small pieces. It is boiled in water. The water is thrown away. The boiled vegetable is now fried in

coconut oil or gingely oil with a pinch of mustard and red pepper powder and a few pinches of *urd ki dal.*

(2) Vegetable is peeled and cut into pieces and is fried in oil straight away with a pinch of mustard and red pepper and a few pinches of *urd ki dal.*

Cootu.

Vegetable is boiled in water which is not thrown away. Boiled ***Arhar ki dal*** or ***Mung ki dal*** is added to vegetable in the proportion of Dal I to vegetable 2 parts—condiments and salt are added to taste. Some times fresh coconut gratings pounded with a little coriander is also added for flavour.

Sambhar.

Two tolas of *Imli* is soaked in 1½ *pao* of water. Then it is boiled with a condiment powder (Red pepper, ***dhania, haldi,*** *zeera* and black pepper). Then *arhar* ***ki dal*** boiled is added to it in proportion of *dal* I part and *sambhar* 2 parts. Both are mixed and boiled again. Some vegetable raw or boiled one is added to it while boiling. Afterwards it is fried in a small quantity of oil, mustard and green *dhania* added afterwards.

Rasum.

Rasam is prepared like *Sambhar* but the quantity of ***dal*** in it is only one half or threefourths of *Sambhar* and no vegetables are added.

Milk Preparations.

Butter milk or *More* (Madrasi name) curd is churned with a little quantity of water.

Khir.—Same as in North India.

Halwa.—Same as in North India.

More Kollumbu.—Green chillies and fresh coconut gratings are pounded with salt and water into a paste and this paste is mixed with curd or *More.* This is kept over fire for 2 minutes. Mustard and green chillies are fried in oil and mixed in the above curd. Sometime boiled vegetable is also added.

Conjee or Gruel (Dalia).

Rice Conjee—Parboiled rice is used. The rice is broken into smaller bits. Rice and water are used in the proportion of 1 and three. Water is first boiled and rice added when the water is boiling. It is cooled and used Sago *conjee* and wheat *conjee* are prepared in a similar way.

Pongal.

Suji or *Rawa* is used in place of *Khichri* or *Pongal*.

Cooked Dal is called Paruppu.

Doshas.

If may be prepared from wheat *suji* or Rice. Rice and *Urd ki Dal* are taken in equal proportions and are

soaked in water separately over night and ground into a paste next morning with a little water. Both the pastes are mixed and fried into round flat cakes.

Idli.

Rice and *Urd ki Dal* are taken in equal proportions and are soaked overnight in water separately. Next morning they are washed and pounded and made into a fine paste separately. Then both are mixed together and allowed to remain over night. Next day cakes are made in special vessels and cooked.

Upma

4 pinches of *Urd ki Dal* with a pinch or two of mustard and bits of green chillies are fried in ghee or oil. Small quantity of Ginger or *Adrak* is also added. Cashew nuts are also fried along. Two parts of water are added and allowed to boil. Salt is added in small quantity. As the water boils add one part of *suji* slowly stirring the mixture carefully. When *suji* is thoroughly cooked, remove it from the pan. Onions may be added along with chillies.

Chutneys

Common one is coconut chutney. *Urd ki dal,* asfoetida and red pepper are first fried in oil. Sufficient

quantity of *Imli* is taken and pounded. Cocoanut gratings are put into it. The whole is mixed.

Indian Drinks

(1) *Shikanjbin* (Lemon squash).—It is a very common drink during the hot weather. Fresh limes are cut across and their juice squeezed out. One lime or *nimbu* is sufficient for one man. It is mixed in one tumblerful of water sugar or salt is added to taste. Ice may be used to cool it. This drink is refreshing and anti scorbutic.

(2) *Shardai or Thandai* Almond (milk).—Almonds are soaked in water till they become tender. Skin is removed. Almonds are now crushed and made into a paste with cold water. Gradually more water is added. For about 20 almonds one tumblerful of water is required. Black Pepper, rose petals, kernel of seeds of melon, cucumber etc. are also added. Sugar is added to taste. This drink is highly nourishing and without black pepper may be used for infants and children. It is especially useful in hot weather and is a good protein supplement to the vegetarian diet.

Almonds can well be replaced by ground nuts. The taste of such a drink will be slightly inferior to that made from almonds but it is in no way inferior in nourishing value.

(3) *Syrups.*—Ordinary sugar dissolved in water or syrup from market re used.

(4) *Lassi.*—Lassi is made from curds or raw milk which are diluted wiih water and sugar added to it. Raw milk should not be used for *lassi*. *Lassi* is highly nourishing and refreshing. Salt may be added to *lassi* prepared from cu .

Barley water, One ounce of pearl barley is boiled in one pint of water. Barley grains are removed by decantation or filtration. The clear water is barley water and is a demulcent drink. If pearl barley is not available, ordinary barley may be taken, soaked in water for some time removing the husk by hand pounding.

Sattu water.—Roasted barley are pulverised and mixed in cold water ½-1 oz. in a pint. This forms a good nourishing and demulcent drink.

Rice water.—Rice water is the water which is separated from the boiled rice. It is generally allowed to go to waste. It is very nourishing and contains starch, proteins, vitamin B_1 and minerals.

Dal ka pani.—It is a form of clear *dal* soup. Any small quantity of *dal* usually of *mung* is boiled in water

($\frac{1}{2}$-1 oz. of *dal* in a pint). The *dal* is removed and clear soup used in illness. Salt and condiments may be added to it.

Tamarind water.—It is prepared from ripe tamarind pods, pods are soked in water and ground into a paste after removing the seeds and mixed with water ($\frac{1}{2}$ oz of tamarind in a pint of water). It is generally taken sweetened and is a good drink in fevers. A slightly more concentrated form is used with rice, *khichri, dalia* or *chappatis.*

Coconut water.—Coconut water from inside the unripe coconut is used in places in South India and Bengal where coconut is common. It is called Dab. It is highly nourishing contains vitamin C and is believed to be anthelmintic.

Sugarcane Juice.—*Ganne ka ras.* In north India fresh raw juice extracted from sugarcane is a very favourite drink during the hot weather. It is highly nourishing and refreshing.

Conjee water.—It is different from *conjee* of South India. Any small quantity of vegetable is boiled raw output in a jar of water. A little salt and powdered mustard are added. This is kept in a warm place for few hours. This water is used with meals as a digestive drink.

Ginger water.—Sonth ka pani A little dried ginger is made into a thick paste with water. Pepper and dried mango pulp may also be added to it. It is mixed with water and salted to taste. It is commonly taken at festivals and marriages. It is a digestive drink.

Zira ka pani. Cumen water. White or black *zira* may be taken. Salt, dried pulp of mangoes (*Amchur*) and pepper are crushed to gether into a paste. *Zira* is roasted on a hot iron pan and made into powder. Similary a little asfoetida is also roasted on a hot iron pan and made into podwer. The powder of *zira* and asfoetida are mixed into the paste and the paste is dissolved in water. This water is digestive and carminative.

It is a pity that tea, coffee, wine are replacing these Indian drinks. Indian drinks have great food value, are cheap, easy to prepare and absolutely harmless under all circumstences, they are free from intoxicants. Tea, coffee and wine stand absolutely no comparison to the Indian drinks, and are more or less intoxicants. Growing publicity of these western drinks is a great danger to the National Health of India and the medical profession should take a note of it.

Bhang (*Indian Hemp*)

Bhang leaves are taken and pounded in to a thick paste with the help of water. It is mixed with *shardai* and

is taken some times on the occasion of festivals, and marriages. Some persons get maniacal symptoms with suicidal or homicidal tendencies under its influence.

Tari.—it is used as drink in south India and is prepared from the juice of a palm tree by fermentation. It is a mild alcoholic drink and contains vitamin B_1.

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Part II

PRACTICAL DIETETICS

CHAPTER XV

Food Allergy

Some people are unable to eat shellfish, oysters, lobesters *milk*, eggs or any other article of diet without getting more or less serious symptoms—like an urticarial rash, vomiting and diarrhœa. This is due to food allergy.

Symptoms of food allergy may be mild or severe. Onset may be acute and sudden or slow being delayed from fifteen minutes to a few hours or a few days or longer. In severe reactions the patient is seriously ill. Mild reactions are much more common and give rise to chronic ill health or recurring illness.

Allergic reactions from food may occur from their ingestion or from mere handling.

Following types of reactions are common :—

(1) Skin manifestations. Recurring attacks of urticaria, eczema, angioneurotic œdema, pruritus are common.

(2) Respiratory symptoms. Bronchial asthma is common and may occur from ingestion or inhalation of any food.

(3) Gastro-intestinal symptoms. These may resemble any serious abdominal trouble like appendicitis, cholecystitis, gastric or duodenal ulcer, intestinal obstruction, gastro enteritis, colicky pains etc. They are quite common and may be acute or chronic.

Abdominal pain in children may be due to food allergy. Some infants develop diarrhea, abdominal pain, and vomiting when the smallest amount of raw whole milk is ingested. Moderate amount of boiled whole milk is tolerated. Some patients may suffer from purpura, urticaria and angioneurotic edema in addition to gastro-intestinal symptoms. Abdominal pain is common in such cases. Pain may vary from mild discomfort to most intense abdominal crises. As a rule the abdominal pain occurs promptly after eating the offending food, but it may appear from several minutes to an hour after ingestion. The symptoms may persist for several minutes, hours or even longer. McCartly and Wiseman think that pylorospasm of early

infancy and its associated abdominal pain may in certain cases be due to food allergy. Diagnosis is made by history, skin test, and eosinophilia. In cases of suspected allergic abdomen an injection of epinephrine or ephedrine orally or atropine by injection or orally may be given. It will promptly relax the allergic spasm and clarify the diagnosis. The most concrete evidence of muscle spasm causing abdominal pain of allergic nature is afforded by roentgen studies.

(4) Nervous symptoms. Any nervous symptoms may apper due to localised œdema of brain or spasm of the cerebral arteries. The most common forms are recurring headaches, migraine, neuralgias, giddiness, epileptiform attacks, visual disturbances, sickness and vomiting

(5) Genito-urinary symptoms. There may be pain on micturition or frequency of urination. Allergy is usually acquired but some hereditary factor may be present. The symptoms may appear at any age. Milk allergy may be present in infants One food may cause one type of reaction the other a different type ; or one type of reaction may be replaced by another after some time.

Diagnosis. (1) History. Allergic diathesis in the family must be inquired in to. Personal or family history of allergic phenomena like headache, migraine, asthma, urticaria, eczema may be present.

(2) Skin Testing. Food extracts may be introduced in to the body by the scratch or intradermal injection. A positive reaction is shown by the appearance of an urticarial wheel surrounded by an erythematous zone.

Treatment. In urgent cases Adrenaline Chloride 1 in 1C00 solution may be used hypodermically in doses of 5—15 ms and may be repeated if necessary.

Ephederine Hydrochlor 1/4—1 gr may be given by mouth.

Permanent results are achieved by discovering the offending article and excluding it from the diet. In some cases desensitization may be effective.

Detection is carried out by four methods :—

(1) By the Addition Diets.

(2) By the Food Diaries.

(3) By the Trial Diet (Bray)

(4) By the Eliminatian Diets of Rowe.

(1) By the Addition Diets. The intestines are cleansed with calomel and magnesia. The patient is placed on one food which hardly ever causes allergic manifestations, for three days. Another food is added each twenty four hours and any allergic symptoms produced are noted. In this way the offending article is discovered.

(2) By the Food Diaries. The patient is instructed to make a record of all foods eaten in twenty-four hours and any allergic phenomen are noted.

(3) By the Trial Diets. Some American writers advocate a trial diet consisting of foods less likely to produce allergic symptoms. It is an egg, milk, wheat and potato free diet because these foods are the most frequent causes of allergy. The patient is placed on the diet until free from symptoms, then one of the excluded foods is added each few days until symptoms recur, when generally the latest addition is the causative food.

(4) By the Elimination Diets of Rowe. It was

discovered that some cases of food allergy did not give positive skin tests, or in other cases treatment based on positive skin tests failed to give relief. Rowe's diets are helpful in such cases as well as for those in whom skin reactions can not be carried out. Rowe's diet consists of a series of trial diets each differing from the others so far as possible containing foods which only rarely produce allergic reactions. The diet which does not produce symptoms is found out by trial of these diets. To this basic diet new foods are added every three or four days and thus the offending article is discovered and then excluded permanently.

The foods which cause allergic reactions in order of frequency are :—

Eggs, milk, wheat, potatoes, chocolate, cabbage, tomatoes, oranges, cauliflower, strawberries, bananas, walnuts, carrots, pork, salmon, oysters, lobesters, crabs, lettuce, celery, peaches, grapes, cherries, raisins figs, lemons, almonds, beef, lamb, mustard and coffee.

Among those least likely to cause trouble are :—

Poulty, turnips, peas, beans, prunes, honey, beetroot, radishes, asparagus, mushrooms, plums, pepper, vinegar and tea.

CHAPTER XVI

Diet during Pregnancy and Lactation

It is only recently that attention has been drawn to the importance of diet during pregnancy and lactation. A diet adequate for a normal female may be found to be quite inadequate during these periods. The growing fœtus and suckling infant make unusual demands on the organism of the mother and the Nature always sacrifices the needs of the mother to that of her child. The fœtus must be supplied iron at the cost of the mother ; the former will have a normal blood hæmoglobin though mother may be anæmic. Same is true for elements like Calcium and Phosphorus. If the diet is deficient in these minerals to supply the needs of the fœtus or the suckling, mother's body resources must be tapped to supply Calcium and Phosphorus to the child, and consequently the mother falls prey to osteomalacia. Vitamin deficiencies become very common during these periods for the same reasons.

Inadequate diet during pregnancy and lactation is a prominent cause of maternal as well as infantile morbidity and mortality. It lowers the

vitality and paves the road for all sorts of infections.

Malnutrition during pregnancy is an important factor in maternal and infantile morbidity and mortality. A well nourished mother can stand the risks of pregnancy much better and there will be fewer complications. Mothers on poor diet during pregnancy fall an easy prey to puerpeural sepsis, the labour is difficult and prolonged and there are greater chances of post-partum haemorrhage. Incidence of premature births increase with poor diet. Dental caries in the mother and the infant is also related to maternal diet. Incidence of caries increases during pregnancy on account of greater demands on maternal stores of calcium. Dental decay in the mother and child can be prevented by giving calcium and vitamins to the mother during pregnancy.

The effect of the maternal diet on the infant are equally important. A large wastage of child life associated with child birth is intimately connected with malnutrition in the mother. Church, Foster and Asher showed that the diet of the mother was a factor in the survival of the offspring from the risks

of infection. Infants born to mothers on poor diet are weak and fall easy prey to diseases. Infant mortality is very high under such circumstances. It has been shown recently that dietary supplements to the pregnant mother appreciably lowered the incidence of illness in infants up to 6 months of age. For example 31 per cent of the infants of mothers on ordinary diets suffered from some respiratory affection, compared with 8 per cent of the infants of the mother on supplemented diets. Similarly, 25 per cent of the former were anaemic, compared with 10% of the latter. Similarly corelation between the physical condition of the infant and the prenatal diet was very high. Fifty six per cent children of of superior physical condition were of mothers whose diet was good or excellent. Seventynine per cent children of poor physical condition were of mothers whose diet was poor. Similarly, of the mothers whose diet was good 94% of the infants were good and 3 per cent poor ; of mothers whose diet was poor to very poor the figures were 8 per cent and 67 per cent of poor infants.

Further, there was a close relationship between the prenatal diets and the height and weight of infants at birth. Infants from mothers on good

diets were 51.8 cm and 8.5 lb at birth : infants from mother on poor diets were 47.2 cm and 5.8 lb. All the still born infants and all the premature infants and all but one of those who died within a few days were born to mothers whose diets during pregnancy were very inadequate. (*B. M. J. 4-11-1944* : *.603—609*)

Dietary defeciencies during pregnancy are common. The most important deficiency is protein deficiency. .Maternal diet in India is grossly deficient in proteins, especially among the vegetarians and rice eaters. No statistical data is available even in advanced and rich countries like U.S.A. protein deficiency in the diet of pregnant mother is very common. Many workers have studied the diet of pregnant mothers. In one group of 514 pregnant women studied in Phildelphia 92.7 per cent of the group recieved less than the recommended allowance of 1.5 gm per kilogram of body weight daily. R. E. Arnell et al studied the protein content of dietary of 400 pregnant mothers. The optimum level of protein intake recommended by the Food and Nutrition Board of the National Research Council (U. S. A.) is a daily allowance of at least 85 gms of protein during the latter half of pregnancy

and 2/3 of this level. is regarded as a minimum subsitence level. Diets which fail to meet 50 per cent of the recommended optimum daily allowance (less than 42.5 gm) are to be regarded as deficient in protein content. Proteins derived from animal sources should be at least 65 per cent of the total intake. A study of diets of the 400 mothers revealed the following :—

(1)	Excellent	taking	85 gm or more	daily	38 cases
(2)	Good	,,	70—84 gm	daily	46 cases
(3)	Fair	,,	55—69 ,,	,,	149 ,,
(4)	Poor		42.5—54	,,	95 ,,
(5)	Very poor	under	42.5	,,	72 ,,

Results of Protein deficiency. The results which follow inadequate protein nutrition are neither so characteristic nor so dramatic as those which follow other types of malnutrition. Subclinical protein malnutrition, although exceedingly common usually causes little more than a slow and insidious wasting away of all the tissues with associated weakness and general ill health. Protein deficiency gives rise to lowered serum protein content of the blood which predisposes to edema. Idiopathic edema is much more common in protein deficiency

cases and so is anemia. Mild degrees of edema in such cases is present for weeks and suddenly it changes in to massive edema. Edema usually involves the lower extremities and trunk and in few instances upper extremities and face also. But the patient chiefly complains about edema about the vulva. Toxaemias of pregnancy are also related to protein deficiency. Tompkins studied two groups of women, a control group recieving diet of their own choosing and a study group recieving a balanced diet with 110 gms of protein daily. It was noted that toxaemia and mild hypertension were four times more frequent in the control group, edema was five times as frequent, preeclampsia eight times as frequent. Holmes found toxaemia twice as common in mothers on low protein group than on high protein group. Protein deficiency lowers the general as well as the specific resistance of the patient. The proteins are of great importance in the chemical defence of the body against bacterial invasion ; Antibody production and active immunity are closely connected with protein metabolism.

Mccance, Widdowson and Lehman found that a high protein diet facilitated absorption of cal-

cium. They found that in the presence of a high protein intake 15 per cent of the calcium was absorbed as compared with an absorption of only 5 per cent in the case of a low protien diet. Deficiency of protein causes poor muscle tone and poor milk supply from breasts of mother. An increase in protein in the diet tends to increase the yeild of breast milk. In milch cattle the milk yield was found to vary directly with the protein intake.

Calcium, Phosphorus and Vitamin D. Maternal diet must be rich in these elements. A decrease in the serum calcium in the last months of pregnancy has been reported (Nicholas et al). Lack of calcium produces complaints as muscle soreness, spasms, numbness, tingling and neuritis and these complaints are cured by giving calcium and vitamin D which is necessary for the proper retention of calcium. Amount of calcium and vitamin D in the mother's diet affects the density of the infant's bones and the structure of the teeth. Maternal diet poor in vitamin D and calcium predisposes to fetal rickets and rickets.

Vitamin A. Mason noted an increased rate of premature births and still births in animals on

vitamin A deficient diets. Maternal diet poor in vitamin A predisposes to defective teeth in the infant ; and may predispose mother to toxaemia.

Vitamin B Complex. Requirements of vitamin B, are increased during pregnancy and lactation. Many complaints during pregnancy such as fatigue, cramps, paraesthesias, dyspnoea, aches and pains are benifitted by vitamin B intake. Polyneuritis in pregnancy may occur. Vitamin B, is said to stimulate the secretion of milk and the amount of this vitamin in mother's milk depend on the amount of Vitamin B in the mother's diets. Milk of mothers suffering from beri beri produces symptoms of beri beri in the infant and a peculiar type of toxaemia.

Vitamin C. The amount of vitamin C in the breast milk is dependent on the dietary intake of the mother, so scurvy in breast fed children is unlikely if maternal intake of Vitamin C is sufficient.

Vitamin K. The administration of vitamin K to the mother just before the onset of labour or during labour has a definite effect on the prothrombin time of the infant & so in preventing incidence of haemorrhagic disease.

Diet During Pregnancy

Caloric value. It should be at least 2400 calories.

Protein. Protein requirement increases during pregnancy on account of the increasing size of faetus, uterus and placenta. It should be about 1 gm per kilogramme of body weight during the first three months, increased gradually to 1.5 gm per kilogramme during the latter part. Major proportion of protein should come from animal sources, milk, cheese, curds, meat, fish and eggs. Roughly speaking from 85 gm—120 gm of proteins are required daily.

Carbohydrate and fats. Should make up the remaining calories of the diet.

Mineral Salts. Calcium is required for bones of the faetus. It should be from 1—2 gm daily.

Phosphorus. It should be from 1.5—2 grammes daily.

Iron. Iron should be from 18—20 mg daily.

Vitamins. Vitamin A 6000 units daily.
Vitamin B_1 500 units daily.

Riboflavin	2.5 mg. daily.
Niacin	100 mg. daily.
Vitamin C	100 mg. daily.
Vitamin D	700 units daily.

Translated in to the term of food it comes to roughly the following amount :—

Milk 40 ounces ; cheese 1 ounce ; butter 2 ounces ; egg 1 serving ; meat 1 serving, potato 1 serving ; yellow or green leafy vegetables 1 serving, vegetables such as cabbage, turnip or tomato 1 serving ; orange juice 3 ounces or tomato juice 7 ounces ; other fruits 1 serving, whole grain or enriched bread, 4 slices, whole grain or restored cereal 1 serving. A supplement of fish liver oil or its equivalent should be given to provide 400—800 units of vitamin D (J. H. Ebbs).

Lactation. The dieting is on the same lines as during pregnancy. But further increment in caloric value and certain elements is required.

(1) *Quantity.* The League of Nation's Commission assesses food requirements during the nursing period as 3000 C. daily. An infant from birth to six months of age requires 50 calories and after six

months 45 calories per pound of body weight daily. So if the baby's weight at birth is taken as 7 lbs. the mother would require an additional 350 Calories at the begining of lactation, gradually increasing to about 700 after the sixth month according to the weight of the child.

Quality. The mother requires about 2 grammes of protein per kilogram of body weight during lactation. From 100—120 Gm. of protein daily are required as the infant draws upon heavily on the nitrogen of maternal body through breast feeding.

Ebbs demonstrated the advantage of a high protein diet in promoting successful breast feeding. In a study of three groups of women with low income, dietary supplements of protein of high biologic value, milk, eggs and cheese were furnished to one group. The members of a second group were educated and encouraged to provide a good antepartum diet. The first two groups were much more successful in nursing their infants than the mothers in the third group. Breast feeding was considered successful in 95 per cent of those women with supplemented diet, 88 per cent in those edu-

cated to a good diet, and only 81 per cent in the poor diet group.

If enough protein is not furnished in the maternal diet to supply both maintenance needs of the mother and the protein of the milk secreted, a loss of maternal body tissue will occur. Other elements required are:—

Calcium	2.0 gms daily
Iron	15.0 mg daily
Vitamin A	8000 units daily
Vitamin B_1	2.3 mg daily
Riboflavin	3.0 mg daily
Niacin	150 mg daily
Vitamin C	150 mg daily
Vitamin D	400—800 units.

CHAPTER XVII

Deficiency Diseases

Grahm Lusk defined nutrition as the sum of the processes concerned in the growth, maintenance and repair of the living body as a whole or its constituent parts. Nutrition depends upon several factors such as proper food, proper exercise and rest, freedom from worry and emotional excitement, general hygiene, sunlight and inherited characters. But chief among them is food of a proper constitution that provides all the elements and complexes necessary for normal growth. Failure of nutrition is a dominant factor in the production of ill health. Malnutrition in the majority of cases is synonymus with food deficiency. It is very wide spread, not only in poor and backward countries but in rich and civilised countries also. Though poverty is the chief cause, ignorance and food prejudices are also important contributory causes. In the civilised countries food is subjected to many processes of refinement which deprive it of much nutritive value. Acute cases of food deficiency are easily recognised but it is very difficult to detect nutritive failure in its earliest stages in chronic form The signs and symptoms of deficiency disease are

protean in nature and appear slowly, and as it is quite common for several food factors to be deficient the resultant symptoms interact upon each other and produce a complex picture.

Vitamin B_1 for example is found together with nicotinic acid, riboflavine etc and so if vitamin B_1 is deficient in diet, other members of vitamin B complex are also deficient. The resultant picture is a complex one showing deficiency of B_1, riboflavin and nicotinic acid. With this deficiency protein deficiency is also commonly present ; moreover different individuals respond differently to one and the same kind of deficiency.

Gross manifestations of malnutrition apart from specific deficiency diseases are stunting of growth and loss of weight in childhood and loss of weight in the adult or the aged.

The one single cause of nutritive failure is dietary inadequacy which is said to be the primary cause. The other causes are secondary and include factors which either interfere with the ingestion, absorption and utilization of nutrients or increase their requirement, destruction or excretion. These secondary causes are very important and should

always be kept in mind when a cause of nutritive failure is encountered.

(1) *Interference with ingestion.* The greatest factor is vomiting from any cause such as seen in acute gastritis, vomiting of pregnancy and alcoholics. Then comes anorexia and disorders interfering with feeding. Therapeutic diets in diseases like peptic ulcer, nephritis, hypertension, obesity etc. may restrict some essential nutritional factor and cause deficiency.

(2) *Factors interfering with Absorption.* In achlorhydria there is interference with the absorption of vitamin B_1 and C. In obstructive jaundice deficiency of fat soluble vitamins particularly K is common as bile helps the absorption of fat soluble vitamins. Regular use of liquid paraffin may hinder absorption of fat soluble vitamins and give rise to their deficiency. Similarly diarrhoea, purgation and hypermotility of intestines hurrys away the food and no time is left for absorption to take place. Diseases of absorbing portions of intestines, short-circuting or resection may leave too small a surface for the proper absorption of essential nutrients from food.

(3) *Interference with utilization:* This factor most commonly comes into play when liver is not working properly as in cirrhosis, cancer, alcoholism or diabetes. Liver changes carotene in to vitamin A, vitamin B_1 and nicotinic acid into coenzymes. Certain drugs also interfere with utilization. Sulfa-*pyridine inhibits the action of nicotinic acid.*

(4) *Factors increasing bodily requirements.* These factors are commonly seen operating in fevers, physical exertion, hyperthyroidism, pregnancy and lactation. When the metabolism of the body is increased the body requires greater amounts of vitamins, especially vitamin B_1. Johnson et al demonstrated that in a group of men subjected to physical labour equivalent to an output of 4000—5000 calories definite deterioration in physical fitness occurred well within one week of starting labor with a diet deficient in the vitamin B complex. This deterioration was remedied by the entire B complex containing only 0.6 mg of B_1 daily but not by 2.0 mg of B_1 alone.

Sunlight, radiant energy, dirt, filth etc cause skin lesion in persons suffering from nicotinic acid deficiency.

High carbohydrate diets, glucose infusions all necessitate increased use of vitamin B Complex.

(5) *Increased destruction.* In achlorhydria increased destruction of vitamin B_1 and C take place. Certain chemicals like lead, sulfonamides etc have a destructive effect on vitamin B_1, nicotinic acid etc.

(6) *Increased excretion.* Water soluble vitamins are easily washed out of the system in diabetes mellitus, diabetes insipidus, contracted kidney and vitamin B deficiency is quite common under these circumstances. The forcing of fluids, and diuresis used in many therapies may give rise to deficiency. The loss of vitamins by lactation may be a precipitating factor for deficiency disease.

INCIDENCE

(1) *Caloric deficiency.* Caloric deficiency is common all over the world and it is mostly due to faulty distribution and control of food. It becomes especially common during war & famine. Our country is a country of perpetual starvation for millions from day to day. In normal years starvation takes a heavy toll what to say

of abnormal years of famine & war. In 194 about 30 lacs of people died in Bengal alone.

(2) Protein deficiency. This is the commonest deficiency next to caloric deficiency. It is likely to be common in vegetarian diets, diets of pregnant and lactating mothers, during childhood and other conditions of increased demand, destruction or loss of proteins. It is not easily detected in mild cases. In gross forms it gives rise to nutritional edema which is seen very commonly during famines.

Vitamin A deficiency. Is very wide spread in the world. A study in south India in 1937 found as many as 15 per cent of 4000 school children showing xerophthalmia and nyctalopia. In Asiatic countries these diseass were seen in 20—83 per cent of certain groups examined. Condition of Africa is equally bad. In Europe, xerophthalmia is uncommon. In U.S.A. xerophthalmia, Keratomalacia and nyctalopia due to vitamin A deficiency are rare but a high incidence of dark dysadaptation has been reported widely in the U.S.A. and throughout the world. Very mild degrees of conjunctival xerosis detected by corneal microscope and

slitlamp was seen in 86.6 per cent of poor school children in New York city.

Vitamin D deficiency. Disease due to it are :— (1) Rickets (2) Osteomalacia (3) Tetany.

Rickets is very wide spread all over the world. An incidence of 75—97.6 per cent of children having symptoms of rickets has been reported from European countries and U.S.A. and from 0—25 per cent in warmer countries of Asia and Africa.

Osteomalacia. It is very common in India, in China and Japan.

Tetany. It is noted in cases of rickets and osteomalacia. About 30—60 per cent patients suffering from these two diseases develop rickets.

Vitamin B_1 deficiency. Beri beri is common in Asia and Australasia. It is less common in Europe, Africa and America. In the U.S.A. about 20 per cent of chronic alcoholic addicts have neuritic manifestations. Infantile beri beri has a death rate of over 90 per cent.

Nicotinic Acid Deficiency. Pellagra. It is common in U.S.A. in many parts of Africa and less common in India, Russia and China, Japan.

Ariboflavinosis. It is very common in U.S.A., India, China and Africa.

Vitamin C deficiency. Scurvy is common in Africa, China, Australia, Europe and U.S.A.

Vitamian K. Highest incidence is in the newborn. In infants prothrombin deficiency is seen in about 60 per cent of cases and an incidence of retinal haemorrhage as high as 25 per cent has been observed. (Waddel and Maumence).

Symptoms and Signs of Early Deficiency States in Infants and Children

Symptoms	Signs
(1) Lack of appetite	(1) Lack of subcutaneous fat.
(2) Failure to eat adequate break fast.	(2) Wrinkling of skin on light stroking.
(3) Failure to gain steadily in weight.	(3) Poor muscle tone.
(4) Late period of sitting, standing walking.	(4) Pallor.
	(5) Rough skin.

Symptoms	Signs
(5) Aversion to normal play.	(6) Hemorrhage of newborn.
(6) Chronic diarrhœa.	(7) Bad posture.
(7) Inability to sit.	(8) Nasal black heads and white heads.
(8) Pain on sitting or standing.	(9) Soreness of angles of mouth, cheilosis.
(9) Poor sleeping habits.	(10) Rapid heart.
(10) Backwardness in school.	(11) Red tongue.
(11) Repeated respiratory infections.	(12) Square head, wrists enlarged, rib beading.
(12) Photophobia.	(13) Thrush, Vincents' Angina.
(13) Abnormal discharge of tears.	(14) Serious dental abnormalities.
	(15) Corneal and Conjunctival changes.

The diagnosis of early stages deficiency disease is very difficult. The signs and symptoms are not typical and in no other disease complex is there so much variation in the individuals patient's pattern of symptoms as in nutritive failure.

Symptoms and Signs Suggestive of Early Deficiency States in Adolescents & Adults

Symptoms

(1) Lack of appetite.

(2) Lassitude and chronic fatigue.

(3) Loss of weight.

(4) Lack of mental application.

(5) Loss of strength.

(6) History of sore mouth or tongue.

(7) Chronic diarrhœa.

(8) Nervousness and irritability.

(9) Burning, pickling of skin paresthesias.

(10) Night blindness.

(11) Photophobia.

(12) Burning or itching of eyes.

(13) Lacrimation, Abnormal discharge of tears.

Signs

(1) Nasolabial sebaceous plugs.

(2) Sores at corners of mouth, cheilosis.

(3) Vincent's Angina.

(4) Changes in tongue, colour or texture.

(5) Red swollen lingual papillae.

(6) Glossitis.

(7) Papillary atrophy of tongue.

(8) Stomatitis.

(9) Spongy, bleeding gums.

(10) Muscle tenderness of extremities.

(11) Poor muscle tone.

(12) Loss of vibratory sensation.

Symptoms	Signs
(14) Muscle and joint pains, muscle cramps.	(13) Increase or decrease of tendon reflexes.
(15) Sore bleeding gums.	(14) Hyperesthesia of skin.
(16) Tendency to bleed.	(15) Bilateral symmetrical dermatitis.
	(16) Purpura.
	(17) Dermatitis, facial butter fly patch, casal necklace, perineal, scrotal and vulval.
	(18) Thickening and pigmentation of skin over bony prominences.
	(19) Nonspecific vaginitis.
	(20) Follicular hyperkeratosis of extensor surfaces of extremeties.
	(21) Rachitic chest deformity.
	(22) Anaemia not responding to iron.

Symptoms	Signs
	(23) Fatigue of accomodation.
	(24) Vascularization of cornea.
	(25) Conjunctival changes.

Council on Foods and Nutrition of the National Research Council U.S.A.

Protein deficiency. This form of deficiency is very common. Its causes are :—

(1) Deficient amount of protein in the diet or defective digestion or absorption of proteins.

(2) Increased demand of protein in diseases of heightened metabolism such as fever and hyperthyroidism or in states like pregnancy, lactation and growth.

(3) Loss of protein in repeated vomiting or diarrhoea, hemorrhage, albuminuria, burnt body surface, discharging wounds and sinuses or after fractures.

(4) Destruction of proteins in wasting diseases or diseases accompanied by chronic exudation.

(5) Insufficient regeneration of proteins in disorders of liver like cirrhosis, cancer etc.

Signs and Symptoms. In majority of cases there may be no signs and symptoms in early stages. In adults there is feeling of tiredness, lassitude, irritability, easy fatigue and lowered resistance to infection. The convalescence is prolonged and healing of wounds is delayed. In children the growth becomes stunted. Edema is the first clinical sign of protein deficiency and this sort of edema is not associated with symptoms suggesting other causes of edema, notably heart and kidney disease. The edema is strikingly dependent on posture, confined to or greatest in dependent parts. In mild cases it is fugitive. It may appear and disappear and is greatly affected by the environmental temperature and salt and water intake. It is usually bilateral and painless but may be more marked on one side. It. usually develops gradually and insiduously though occasionally the onset is sudden following unusual

exercise or excessive salt and fluid intake. The only certain way to detect protein deficiency in early stages is the measurement of the concentration of the plasma or serum protein. The concentration of protein in the serum (or plasma) can be determined by several methods but most commonly used method is the microkjeldahl procedure with a separation of the two fractions, albumin and globulin either by Howes method or the soduim sulfite method of Campbell and Hanna. If only the total protein is to be determined, the new copper sulfate method of Phillips, Vanslyke et al offers an extremely simple, rapid and reliable procedure. Relative concentrations of albumin and globulin are also determined. In mild and early cases albumin is lowered significantly while the total protein remains within the normal range. Specific gravity method and biuret test may be used. Normal stndards for the concentration of serum or plasma protein of adults are–total protein from 6·0–8·0 gm per 100 C. C, for albumin 4·0–5·5 gm per 100 c. c. and for globulin 1·4–3·0 gm per 100 c. c. (Peters and Eisenman) children above 2 years of age have the same concentration as adults. Blood volume must also be taken into consideration

in detection of early protein deficiency. In acute cases accompanying hemorrhage, shock and some other conditions a determination of blood volume as well as the concentration of serum protein will be necessary. There are no suitable and reliable laboratory methods for the detection of specific amino acid deficiency.

Treatment

Food. Good food by mouth is the most effective and satisfactory way to administer protein. High caloric diet is essential as fats and carbohydrates have protein sparing action. Meats, fish, eggs, milk and cheese whole grain cereals, beans, and peas are all good sources of protein.

Protein Concentrates. If dietary proteins can not be taken hydrolysed protein rich foods may be given orally. Protein concentrates may be administered through a Ryle's tube passed through the nose.

Parenteral Protein Therapy. Concentrated human plasma and albumin solutions are very suitable for intravenous administration. Mixtures of

amino acids may be given intravenously as well as orally.

Nutritional Edema. The most important causative factor is a prolonged protein deficiency. In mild cases the edema may be confined to the lower limbs, but in severe cases it may be generalised. It is accompanied by emaciation, muscular weakness, depression, anemia and gastro enteritis.

Nutritional Anaemias. Microcytic type of anemia results from insufficient dietary intake of iron. It is very common in young children and also in pregnant women. Tropical macrocytic anemia resembling true pernicious anemia is also common. Mostly the cases are seen amongst the vegetarians. Anemia of pregnancy is also a deficiency disease, some cases are due to deficiency of cholestrol in the blood.

(1) VITAMIN A DEFICIENCY. It manifests itself by skin lesions and eye lesions.

(*a*) Skin lesions are common in adults and appear early. The skin is dry and papular called phrynoderma.

(*b*) Eye lesions are common in infants and

children. They manifest themselves as: Xerophthalmia, Hyper keratosis of the conjunctiva, keratomalacia and nyctalopia.

Diagnosis of vitamin A deficiency. This is done by :—

(1) Determination of levels of carotene and vitamin A in blood and body tissues.

(2) Dark adaptation tests by means of photometric instruments.

(3) Microscopic examination of cornea and conjunctiva.

Treatment. In vitamin A deficiency 50,000 units of vitamin A are given daily to an adult for at least two months. The response is slow and treatment over prolonged periods is necessary.

(2) VITAMIN D DEFICIENCY. It manifests itself as rickets, osteomalacia and tetany.

Diagnosis. Early rickets is detected by the determination of serum phosphatase and phosphorus, serum calcium and x-ray examination of long bones.

Treatment. Prevention. Mild form of rickets is quite common in India. One should not depend on the tropical sun too much. The diet of the expectant mother should be rich in milk and vitamin D. Every infant at the age of three weeks should be put on vitamin D. 800 units daily in the form cod liver oil or shark liver oil or halibut liver oil or synthetic preparation. Premature infants may require 3000 units. Raw egg yolk is a very good protective and one egg is sufficient to prevent the disease in an infant. Massive oral or parenteral dose for prophylaxis is very successful. 600,000 units of vitamin D may be injected in an infant at the age of one month and repeated after 6 months. A single oral dose of 7.5—10 mg of either vitamin D2 or D3 dissolved in oil and given to infants between the ages of 2 months and 3 years is very successful. 7.5 mg of calciferol is equal to 300,000. i.u. of vitamin D.

The Prophylaxis of Rickets by Single Massive Doses of Vitamin D.

Several workers observed that infants under 18 months could be protected during the winter months by single oral doses of 7.5—10 mg of either

vitamin D 2 or D 3 dissolved in oil (Harnapp, Hartenstion and Heisler)

The effect of massive doses of vitamin D in 137 infants and children between 2 months and 3 years of age without any radiological or clincal evidence of rickets was investigated. The period of observation lasted for 6 months throughout the winter and early spring. A single dose of 7.5 mg of calciferol i e., 300,000 I. U. of vitamin D 2 dissolved in 1 c.cm. of arachis oil was given by spoon after a milk feed. There after each child was clinically examined at regular intervals of 4 weeks or less and at the end of 6 months another radiograph was taken of the wrist. In mild rickets of short duration obvious alterations in the appearance of the X-ray films may not occur, or may last for so short a time that they may be over looked unless radiographs are taken at frequent intervals.

Results. Of 93 ·infants under 2 years who recieved one dose of 7.5 mg (3000,000 I. U.) 90 remained free from the disease through out the period of observation, of 101 infants under 2 years who recieved cod liver oil 1—4 dr daily (containing

vitamin D 700000. I. U. daily) 20 developed rickets. Of 72 infants under 2 years who recieved no vitamin D and served as controls 33 developed rickets, out of 44 infants under 1 years of age who recieved no vitamin D 30 developed rickets.

Mode of action. After a single large oral dose of vitamin D dissolved in a small amount of oil 93 per cent was absorbed from the bowel. The blood level of vitamin D rose from 50. I. U. to 2700 I. U. and remained above normal for from 3—6 months. The vitamin is stored by the liver and other tissues. In children under 1 year it is always safe to repeat the massive dose after 3 months.

Toxicity of Vitamin D. Most of the toxic effects previously observed have been found to be due to toxic substances produced by the over-irradiation of ergosterol. Pure calciferol is very little toxic if at all. In infants, J. H. Hess at al (1930) found that daily amount up to 50 times the ordinary prophylactic dose could be continued for months, and up to 250 times this dose for short periods, with out ill effect. Steck et al (1937) concluded that 20000. I. U. per

kilogramme of body weight could be given daily for indefinite periods with impunity, but with doses greater than this undesirable symptoms may follow. After daily administration, of from 20,000 to 40,000. I. U. for 6 months to a premature twin, however, Ross and Williams (1939) reported the appearance of anorexia, loss of weight, and vomiting ending in death ; at necropsy there were bronchopneumonia and extensive calcification of arteries, heart muscle, kidney, stomach and lungs.

Advantages Of The Method

(1) It is cheap and economical.

(2) An infant can be given a single small dose of oil by a trained nurse. Repeated administration of cod liver oil may cause gastrointestinal upset or in weak infants lipid pneumonia by aspiration of oil. Premature infants, those, taking thyroid and those growing rapidly after marasmus or on acute illness may require double the above doses, possibly repeated at shorter intervals.

Curative. Children with active mild rickets are given 1600 units daily, advanced cases 5000 units

and refractory cases, 50,000 units or more. In juvenile, adult and senile rickets 10,000 units are given daily. Massive doses may be given at 1—2 month's intervals.

Vitamin B complexdeficiency. Vitamin B complex consists of several members which are found together in natural food stuffs. Generally Vitamin B deficiency gives rise to a complex group of symptoms out of which some symptoms may be ascribed to one or the other members of the group. Treatment by individual members of the group often fails or produces an imbalance and deficieacy of some other member of the group thus giving rise to fresh trouble. Under such circumstances it is always safe to use the whole B complex for therapy. Most important group of symptoms fall under the heading of nutritional neuropathies. These were studied by Peraita during the Spanish Civil War in 1937—1939. Some 98 cases were observed to be suffering from neurological symptoms only without any skin lesions. Females predominated in a ratio of 4:1 and person of 40—60 years of age were in the majority. These cases were divided in to the following groups.

(1) Paraesthetic syndrome.
(2) Paraesthetic–causalgic syndrome.
(3) Retrobulbar neuritis.
(4) Funicular myelopathy.
(5) Cochlear neuritis.
(6) Mixed forms.
(7) Transitional forms.

(1) *Paraesthetic Syndrome.* Started often as tingling sensations in the distal parts of the toes and round the bed of the nails, and later spread to other parts of the foot. Similar sensations in hand were also observed.

(2) *Paraesthetic–causalgic Syndrome.* A very painful sensory disturbance similar to those described after injury of peripheral nerves was observed. Feeling of "cold and wetness" of the feet, burning sensations, and so on were described.

(2) *Funicular myelopathy.* Symptoms due to damage of the posterior sensory spinal tracts, such as absence or diminution of the vibratory senstion and ataxia of a pseudo–tabes types were seen. Little or no disturbance of the functions of the efferent nerves was noted. The ankle and knee-jerks

were rarely diminished, but more often increased. Other symptons were of general character, including weakness, inertia, depression, "neurasthenia" and disturbances of sleep and of the heat regulation. Disturbances of bladder function polyuria, nycturia or paralysis appeared. Many patients had a generalized hypohidrosis. Amenorrhaea or oligomenorrhoea was a constant finding. Erythema or other trophic disturbances were seen. Treatment with yeast led to recovery. Response to B_1 alone or nicotinic acid alone was not so well. Riboflavine proved useless. These may be called deficiencies due to vitamin B complex. *B.M.J. Feb. 26, 1944.*

Biskind et al observed gynecological complaints in 37 cases out of 39 cases of vitamin B deficiency. These patients complained of menorrhagia, metrorrhagia, painfull breasts, premenstrual tension or a combination of these. The response to Vitamin B Complex therapy in these patients was usually prompt and often dramatic. Large doses of entire B complex are needed. Wilkinson described 14 cases of amblyopia associated with vitamin B complex deficiency. Acroparaesthesia, weakness of the extremities, palpitation, giddiness and œdema were

accompanying symptoms. Yeast 60 gm three times a day cured the condition. Nicotinic acid or riboflavine given separately proved useless but the two together cured the condition. *Lancet 22-4-1944.*

Vitamin B_1 Deficiency

(1) *Atypical Cases.* Symptoms depend on the rate at which the deficiency develops but in all cases the subjects become depressed, irritable quarrelsome, uncooperative and fearful other cases complain of burning and pain in the stomach, vomiting, nervousness, insomnia, feeling of coldness and palpitation, dizziness, hallucinations burning of feet, dyspnœa, orthopnea generalised œdema, enlarged and tender liver.

Infants born to mother suffering from Beri beri also suffer from vitamin B_1 deficiency which manifests as anorexia, irritability, convulsions and coma and death. There is very high mortality in these cases.

Typical cases show symptoms of Beri beri in dry or wet form and polyneuritis. In the dry form the patient complains of weakness, numbness and other symptoms of peripheral neuritis. In the

wet form œdema is present in various parts of the body. It may become generalised. The heart is dilated. Vitamin B_1 deficiency may lower the resistance to virus disease In monkeys the signs of mild thiamine deficiency are cessation of normal growth, anorexia, apathy and an unkempt appearance (Waisman et al). More serious thiamine deficiency is characterized by tremors, ptosis , muscularweekness, cachexia and temporary spastic paralyses. These symptoms were alleviated by an adequate amount of vitamin B_1. Monkeys deficient in vitamin B_1 were found to be slightly more susceptible to virus of poliomyelitis.

Diagnosis. B_1 deficiency is determined by the determination of levels of pyruvates and Co-enzymes and B_1 in blood, urinary excretion of B_1 may also be determined.

(1) Pyruvic acid content of blood in normal persons is 0.4—0.6 mgm per 100 c. c. In vitamin B deficiency pyruvic acid accumulates in blood and the total contents may go up to 6 mgm per 100 c. c. of blood.

Volhard's Diuresis test. In the morning one litre of water is given to the fasting person to

drink Diuresis is recorded half hourly for 4 hours, by which time all the ingested water will be excreted by a normal person. In B_1 deficiency there is delayed excretion and this excretion is restored to normal by B_1 administration Glucose Tolerance curve. In B_1 deficiency cases it resembles mild diabetic type of curve.

Prophylactic. Beri-beri is common where rice is the staple diet. Hand pounded or parboiled rice should be used and rice should not be washed frequently. The rice water left in cooked rice should not be thrown away. Rice polishings or wheat bran may be soaked in water for some time and water should be taken. Yeast or synthetic vitamin B_1 preparation may be used.

Curative. Vitamin B_1 is given in large doses 50 mg—100 mg daily and preferrably by the intravenons route. Orally vitamin B_1 may be given in doses of 20 mg—50 mg daily. For treatment these massive doses are essential. Once the disease is under control food rich in vitamin B_1 may be continued. Bran, rice polishing, whole grains, yeast are rich in vitamin B_1. It is better to give the whole B complex.

Riboflavin Deficiency. Typical cases show inflammation of the lips, fissures at the corners of the mouth, glossitis, dermatitis and vascularising keratitis. A typical case may suffer from insomnia. Only one eye may be affected. The eye is usually red, itchy and bloodshot. Ocular symptoms appear to be very constant and may appear before other symptoms of the deficiency.

Diagnosis. Slit lamp and biomicroscopic examinations of the capillaries in the conjunctive and cornea are very valuable. Determinations of riboflavin in blood and urine are made.

Treatment. Riboflavin is given in doses of 5—10 mg twice daily, in acute cases intravenous injections may be used.

Niacin (Nicotinic Acid) Deficiency. Typical cases of nicotinic acid deficiency show symptoms of pellagra. Atypical cases are very common. Such patients complain of weakness and loss of apetite. Some persons complain of giddiness or weakness of memory. In adults apprehension, agitation, depression and delirium may be present. Sometimes the patient is irrational, may have

delusions and dis-orientation of time and place. There may be visual and auditory hallucinations. There is a monosymptomatic stage when only one symptom of glossitis is present. Other cases may show scarlet red stomatitis with or without secondary vincent's infection, nonspecific urethritis, balanitis, vaginitis or mental symptoms like encephalopathy, progressive stupor and hebetude. In infants anorexia, diarrhoea, redness of tongue and mucous membrane of the mouth or ulceration may be seen. Aykroyd has reported cases of "nutritional Diarrhoea" due to nicotinic acid deficiency. These cases are common in Orissa, C. P. and Madras where rice is the principal diet and consumption of milk and protective foods in general is low. Some 54 cases were observed and known causes of diarrhoea such as sprue, chronic amoebiasis, tuberculous enteritis were excluded. The onset of the disease was usually gradual. The disease started with the patient passing 1—2 loose stools after food. Gradually the number increased and in a severe case, nearly a dozen motions were passed in a day. Passage of motions was not associated with tenesmus Abdominal pain and griping were absent but

vague abdominal dis-comfort was present in all cases. The patients often complained of gurgling noises in the abdomen. Soreness of the tongue with inability to take hot spicy foods, was complained of by 49 :patients. The patients complained of weakness and inability to make an effort. Oedema of the dependent parts was present in 25 cases. In 15 patients dermatitis was present. 49 cases showed glossitis. 28 cases showed total lack of free hydrochloric acid and hypochlorhydria in 13 cases. A striking reponse to the administration of nicotinic acid was obtained in 50 cases. In severe cases 100 mg of nicotinic acid were injected intramuscularly daily. In milder cases 50—75 mg a day were given according to the severity of the case. Improvement was usually apparent after the third injection The motions became reduced in number and become formed. Patients who passed over 10 loose motions before treatment was begun usually had only 4 semisold motions after the third injection. The diarrhoea was controlled within 12 days in all 50 cases.

Diagnosis. Determinations of nicotinic acid in the blood and urine is made. Urine is tested

for porphyrin. The B. E. S, test of Beek, Ellenger and Spies is useful.

Treatment. In infants and children a dose of 50 mg of nicotinic acid is given thrice daily. In adults in mild cases 50 mg three times daily is enough. Severe cases require 150 mg thrice daily. For rapid effect the drug should be given by parenteral method. If the drug produces unpleasant symptoms the amide may be used.

Infantile Pellagra

Infantile pellagra was found to be present in 60 per cent cases out of 300 children suffering from acute malnutrition by T. Gillman and J. Gillman. Severe cases had edema of the extremities, face, eyelids and genitalia, skin lesions on the legs, buttocks, back, arms and face, gray hair or alopecia, as well as patchy or diffuse dermal depigmentation. The stools were as a rule, bulky, pale and foul swelling and contained much unsplit fat. Liver showed fatty degeneration. In severe cases Nicotinic acid and vitamin B complex not only proved useless but proved harmful, aggravating the condition and intensifying the accumulation of fat in the liver cells. Crude

liver extract injections proved more useful but the ideal drug for such cases was dried stomach in 10 Gm doses daily in combination with hydrochloric acid which lead to spectacular recovery of the patient and loss of edema fluid. The fat in the liver disappeared rapidly and almost completely in every instance. All the patients treated with dried stomach recovered. The authors think that the administration of vitamins in severe nutritional edema associated with pellagrous lesions in infants can be extremely dangerous and is contra indicated.

—J. A. M. A. Sept. 1, 1945 (12—19).

It has been pointed out that excessive dosing with one particular factor of the B complex may induce secondary deficiencies in the other factors of B complex. So in treating the clinica syndromes of beri beri, pellagra or ariboflavinosis a formula containing the whole B complex should be used, or B_1, nicotinic acid or riboflavin should be given together. A formula containing 10 mg thiamine. 50 mg niacin, 5 mg riboflavin and 75 mg vitamin C is advised by Tom. D. Spies for all the above diseases and if the symptoms of one deficiency predominate addition to

the basic formula of the vitamin specific for the predominating deficiency may be made. In the case of beri beri, 10 mg of B_1 is added daily; in riboflavin deficiency 5 mg of riboflavin, twice a day and in pellagra 50 mg of niacin thrice a day.

Dried brewer's yeast, liver extract, wheat germ and rice polishings are excellent therapeutic agents for the treatment of diseases arising from deficiency of the B Complex Vitamins.

Dose of brewers yeast is 4—6 ounces daily, wheat germ 5—10 ounces, rice bran 2—4 ounces daily.

Vitamin C Deficiency. The typical cases show the symptoms and signs of scurvy. Atypical cases suffer from anorexia, anemia, under nutrition and haemorrhagic tendencies. A monosymptomatic stage in which gingivitis is the only symptom is described.

Scorbutic Epiphysitis. Branwell-cooke has described a condition of 'pseudo-paralysis' of the legs due to scorbutic epiphysitis. The gums are usually normal. Purpuric haemorrhages in the skin were not seen in any of his series. The knees are the joints

usually affected. They present a diffuse, rounded, swollen appearance tender to touch and painful on passive movement, especially extension. In some cases the external appearance is quite normal but a skiagram will reveal a scorbutic epiphysitis. Occasionally only one knee joint is affected. Extravasation of blood may occur over the spine, in which case a diagnosis of tuberculosis of the spine may be arrived at.

Oral and Parenteral use of vitamin C brings about a rapid cure.

Diagnosis. X-ray examination of the long bones.

2. Vitamin C determination of plasma.
3. Dichloro indo phenal test for urine.
4. Intradermal test of C. Rotter with dichloro-indo phenol solution.
5. Capillary resistance or fragility.

Treatment. Large doses of vitamin C are needed for infantile or adult scruvy. 50 mg thrice a day is the minimum dose. Large doses may be given by intramuscular or intravenous injections daily.

Vitamin K deficiency. Vitamin K deficiency commonly arises during the course of liver disease.

New born infant suffers from hypo-prothrombinaemia and is liable to haemorrhagic disease.

This is prevented by giving vitamin K to the mother 25 mg menaphthone or 50 mg of aceto menaphthone at the beginning of labour or 5 mg menaphthone to the baby soon after the birth. The minimum dose for the baby is ½—1 mg of a vitamin K analogue and is effective when given orally or by injection. This prophylaxis would save at least 1·6 infants per 1000 infants from death due to haemorrhagic disease.

CHAPTER XVIII

Diet in Infancy

Breast feeding. Breast feeding should be the ideal of feeding infants during the first six months or preferably during the first nine months of life. Both the mortality and morbidity rates amongst the breast fed infants are much lower than amongst the bottle fed infants. This is the period of active growth and the infant is building its soft tissues and bones. It must have plenty of good building material in its diet and in human milk protein we have an ideal tissue builder. The infant needs fat as a concentrated energy food as well as tissue builder. Nervous system, bone marrow and other tissues need fat. Carbohydrate is needed for the smooth working of protein and fat metabolism as well as for body working and in lactose we find the ideal carbohydrate which fulfils all these functions without undergoing fermentation in the intestine. Besides this human milk contains valuable minerals; anti bodies immunogens and Vitamins excepting Vitamin D.

Composition of Human milk (Camerer and Soldner.)

Specific Gravity 1032 Reaction Alkaline.

Water	87·75 per cent.	Milk Sugar	6·26%
Solids	12·25 ,, ,,	Mineral matter	0·27%
Protein	1·62 ,, ,,	Citric acid	0·05%
Fat	3·14 ,, ,,	Extractives	0·91%

A healthy woman produces from 1/½—3/½ pints of milk daily.

Variations in composition at different periods of suckling.

(1) During the first two or three days. The milk secreted during this period is called Colostrum. It contains greater amount of fat and protein than ordinary milk and acts as a laxative.

(2) During the first few weeks the infant grows much faster than subsequently. He requires more building material at this stage consequently the milk is richer in proteins and mineral salts. As the daily muscular activity of the infant increases he requires more and more carbohydrate which is found in greater amount in the milk of the later period than that of the earlier period.

Composition of Human Milk at Different Periods of Lactation (Camerer and Soldner).

Period.	Protein	Fat	Sugar	Ash	Increase in Child's Weight per day
5th day	2·0	2·8	5·4	0·34	35–40 Gms.
8th to 11th day	1·6	3·1	6·2	0·27	
20th to 40th day	1·1	3·8	6·4	0·22	
70th to 120th	1·1	2·9	6 7	0·20	22 ,,
170th & after	0·8	2·6	6·8	0·19	18 ,,

Breast-feeding. An infant under six pounds should at birth receive six feeds during twenty four hours. Five feeds at three-hourly interval during the day and one at night at eight hourly interval.

An infant seven pounds or more at birth should receive five feeds in twenty four hours. Four at four-hourly interval during the day and one at eight-hourly interval during night,

How Often is the baby to be fed ? The full term baby should have either three hourly or four hourly feeds. The former means that it should gets its feeds at 6 A.M., 9 A.M., 12 Noon, 3 P.M., 6 P.M. and 9 P.M. and a drink of water during the night if needed. This amounts to 6 feeds during the 24

hours. Four hourly feeds are given at 6 A.M., 10 A.M., 2 P.M., 6 P.M. and 10 P.M. amounting to five feeds in the twenty four hours. It is a good general Rule to start 3 hourly feeds and continue for the first two months or until the baby is about 10 lbs. in weight, after which 4 hourly feeds are resumed. The baby should have 7—10 minutes at each breast at every feed beginning at alternate sides. The babie's requirement of breast milk is calculated by considering progress in weight which denotes it rate of growth. Roughly speaking an infant requires 2½ ounces of breast milk per pound of body weight *e. g.* an 8 lb baby should get 20 ozs per day. The baby if satisfactorily fed should increase by 5—6 ounces per week after the first week for the first three months, and thereafter by about 4 oz per week for the next three months. He should be happy and contended and spend his life mostly in sleeping and feeding. He should pass stools 2—3 times a day and the stools should be healthy.

An average male infant requires the following amount of breast milk daily :—(40—45 calories per lb of weight per day).

During	1st	week	290	grammes	or	10	ounces.
,,	2nd	week	540	,,	,,	18	,,
,,	3rd	week	560	,,	,,	19	,,
,,	4th	week	600	,,	,,	20	,,
,,	2nd	month	660	,,	,,	22	,,
,,	3rd	month	720	,,	,,	24	,,
,,	4th	month	800	,,	,,	26	,,
,,	5th	month	860	,,	,,	28	,,
,,	6th	month	900	,,	,,	30	,,
,,	7th	month	960	,,	,,	32	,,
,,	8th	month	1020	,,	,,	34	,,
,,	9th	month	1080	,,	,,	36	,,

The quality of breast milk changes from time to time to suit the bodily needs of the infant. The infants grows much more quickly during the first few weeks and the milk during these days is richer than those of later period Colostrum or the milk during the first few days is richer in protein and fat than the ordinary milk. Subsequently the milk undergoes changes with the progress of lactation. The rate of growth of the infant decreases with age and so does the amount of protein in milk progressive falls as lesser building material is required. The child increases its activity and the amount of fat and carbohydrate in milk increase. The quantity of milk increases

in proportion to the demand for nourishment by the infant. The quantity and the quality of breast milk depends on the health and diet of the mother. Health and growth of the infant depends on the quality and quantity of the breast milk.

Baumm and Illner studied the effect of maternal diet on breast milk very carefully and reached the following conclusions :—

(1) Up to a certain limit the composition of the breast milk is largely independent of the diet. Even if the supply of food to the mother is entirely stopped, the mother goes on producing milk for some time till almost starved to death. The quality of such a milk is only slightly different from that of a healthy mother but a grossly defective diet of mother for a prolonged time leads to much more serious changes in breast milk. This is much more true in the case of vitamins and minerals. The breast milk of a mother suffering from Beri beri is not only deficient in Vitamin B_1 but is full of toxic products of incomplete combustion of carbohydrates like pyruwates which produce serious toxic phenomena in the infant and may lead to death.

Mother who is suffering from osteomalacia or whose diet is defective in calcium and Vitamin D will produce milk deficient in these constituents and will produce rickets in infant. Shortage of Vitamin A in diet will lead to Xeropthalmia in the infant. Taking of certain drugs by the mother also may have some influence on the child through their excretion in milk. Taking of alcohol and tea by the mother do not appreciably affect the infant directly as very little of these is excreted in milk. They may indirectly affect the infant through affecting the general health of the mother. Sulfonamides taken by the mother are also excreted to a very small extent in the milk and are not likely to affect the infant. Some purgatives of anthracene group taken by the mother are excreted in sufficient amount in breast milk to produce diarrhoea in infants. The ingredient of the milk which is subject to alteration by the maternal diet is fat. There may be as much variations as 10 per cent in the amount of fat in milk. An abundant ordinary diet increases the percentage of fat in milk and so does the increase in nitrogenous products in the maternal diet. If

carbohydrates alone are increased it had no influence upon the amount of fat. An increased amount of fat in the diet rather decreased the amount of fat in milk. Increased fluid in-take does not alter the quality of milk nor increases its quantity. Like wise excessive sodium chloride in the maternal diet had no effect on milk.

Increased stimulation of the breast increases the quantity of milk and increases its richness. Frequent suckling is the best stimulus and if repeated at short intervals causes the richness of the milk to increase and so milk may become less digestible.

The next question arises—is the breast milk a complete food for the infant, or is it required to be supplemented with other foodstuffs ? This question will be answered by the comparison of the child's requirements of various proximate principles with the amount of those proximate principles present in the breast milk. From what has been said before we do not dispute about the adequacy of breast milk to supply protein, fats and carbohydrate. Now we want to judge the adequacy of breast milk from the view of supply of vitamins and minerals. An infant needs the following amounts of vitamins and minerals.

(1)	Vitamin	A	1500 Units daily.
(2)	Vitamin	D	350 Units daily.
(3)	Vitamin	B	300 Units or 1 mg.
(4)	Vitamin	C	15—50 mg daily.
(5)	Calcium		About 720 mg daily.
(6)	Iron		About 5 mg daily.

We have no exact data about the amount of vitamins present in breast milk but it may be taken for granted that the breast milk of a mother on ordinary diet contains same amount of vitamins as cow's milk. These amounts are ;—

Vitamin A is present from 70—100 units per ounce of milk and an infant takes about 20, 30, 40 ounces of milk at 1 month, 6 month and 9 months. The amount of vitamin A will be 1400, 2100 and 2800 units and this will probably be quite sufficient. Extra supplements of vitamin A are not needed for a normal infant.

Vitamin D. Milk contains only $2\frac{1}{2}$ units of vitamin D and an infant taking 20, 30, 40 ounces of milk at 1 month, 6 months and 9 months will contain only 50, 70, 100 units of vitamin D as against the requirement of 750 units daily. So it is absolutely necessary to supply vitamin D to the

infant in the form of cod liver oil (1—2 teaspoonful) Halibut liver oil 20—30 drops or other vitamin D concentrates or yolk of one egg. This is absolutely essential. Vitamin D requirement is balanced by sunshine to some extent in this country.

Vitamin B. Milk contains 7 units per ounce and the infant taking 20, 30 or 40 ounces will get 140, 210, and 280 units respectively and the shortage of vitamin B_1 is not expected to be appreciable unless mother is suffering from vitamin B_1 deficiency. However it is safe to gives about $^1/_2$ mg or 150 units of vitamin B to the infant.

Vitamin C. 1 oz of milk contains 0·3 mg and the baby taking the usual amount of milk will get 3 mg, 6 mg, 10 mg only as against a requirement of 15–50 mg daily. So vitamin C in the form of orange juice or lemon juice or synthetic preparation must be given to the infant. Juice of $^1/_2$—1 orange daily is required.

Calcium. An infant needs 750 mg daily and this is quite well covered by the milk. Cow's milk is richer in calcium.

Iron. 5 mg daily is required and an infant may suffer from anaemia after the first six months Ferri et am. citras 5 gr may be given daily.

The baby must be fed at regular intervals and frequent and random putting to breast is very harmful. In hot weather the baby should be given plain boiled water also between the feeds.

Artificial Feeding.

Let us first compare human milk and cow's milk to note the differences.

	Human milk	Cow's milk
Protein	2·0 %	4·0 %
Fat	4·0 %	4·0 %
Carbohydrate	6·5 %	4·5 %
Ca	0·02 %	0·12 %
Salts	0·2 %	0·6 %
Water	8·73 %	8.69 %

1 The proteins of human milk consists of 2/3 of soluble proteins (lactalbumin and lactglobulin) and 1/3 of insoluble protein (caseinogen). Cow's milk protein consist of only 1/5 of soluble proteins and 4/5 of insoluble proteins. Insoluble proteins are likely to upset the baby's digestion as it

forms thicker and denser curds. If we dilute the cow's milk and reduce the total of proteins from 4 per cent—to 2 per cent we still have to deal with the large proportion of casienogen and in certain difficult cases no amount of diluting or "humanising" will be of use.

2 Fat in human milk is in a finer state of sub-division. Cow's milk fat is not so and so less easily digested. Cow's milk fat has higher melting point.

3 Cow's milk is poor in carbohydrate. By diluting it is reduced still lower as dilution is necessary to reduce the percentage of protein.

4 Salts. Cow's milk contains only about 1/10 of the amount of iron present in human milk and it contains five times as much calcium and much more sodium and potassium salts. It is acidic in reaction. The deficiency of iron which becomes exaggerated by dilution leads to anaemia in bottle fed babies. High percentage of calcium and of casienogen make cow's milk more indigestible.

There are two chief methods of artificial feeding :—

(1) The "Percentage Method." In this method milk is diluted with water, then cream and sugar are added in order to make the resultant mixture resemble human milk.

(2) The "Dilution with addition of Sugar" method. Milk is diluted and sugar added in certain proportions.

General Principles on which artificial feeding is based are :—

(1) The infant requires $1\frac{1}{2}$ ounces of Cow's milk in the twenty four hours for each pound of body weight.

(2) Amount of Sugar required in 24 hours is 1/8—1/10 of an ounce per pound of body weight.

(3) Amount of fluid required is 2—$2\frac{1}{2}$ ounces per pound of body weight.

(4) Caloric needs of infant are about 40—50 calories per pound of body weight in twenty four hours.

For exampie an infant weighing 8 lbs needs in twenty four hours.

Cow's Milk $= 1\frac{1}{2} \times 8 = 12$ ounces.
Sugar $= \frac{1}{8} \times 8 = 1$ ounce.
Fluid $= 2\frac{1}{2} \times 8 = 20$ ounces.

As there are 12 ounces of fluid in the milk already the infant will require only 8 ounces of additional water.

Therefore the deit wiil be :—

Cow's Milk	12	ounces.
Sugar	1	ounces.
Water	8	ounces.

This twenty four hours requirement can be divided into five feeds. So each feed will be equal to 4 ounces of mixture. This mixture will be deficient in fat. One tea-spoonful of 40 per cent cream may be added to each 4 oz. feed to make it more nearer the human milk in composition. But there is danger of fat dyspepsia and addition of fat (cream) may be omitted.

Difficulties in feeding with cow's milk.

(1) Protein indigestion. Thick curds of insoluble protein (caseinogen) is the cause of this

trouble. The symptoms are crying (due to colicky pains) and restlessness with perhaps vomiting of curds, soon after feed. Constipation is common due to excessive calcium in cow's milk. The stools are firm and lumpy, rubber like in consistency, pale in colour and tend to adhere the napkin. The lumps are curds of calcium caseinate. The baby's weight remains stationary or he may loose weight. A popular remedy for this is to add 2 grs of sodium citrate to each feed. It helps to prevent large curds from forming. Barley water should be used to dilute the milk instead of plain water. If this is not successful the milk should be boiled for five minutes. Boiling modifices the casein curd. Another method is by the use of lactic acid milk.

Lactic Acid Milk.

To each pint of boiled milk, which has been allowed to cool to blood heat (98·4°F), from 40—60 drops of 40 per cent lactic acid are added drop by drop with constant stirring. A finely divided clot results which is quite digestible. This method does not cover the fluid requirements of the infants and therefore the infant should be given water between feeds.

Citrated Milk

Addition of I gr. of sodium citrate to each ounce of Cow's milk makes the caseinogen more digestible. In the case of very weak or very young infants dilution of milk may be done more freely. Equal parts of milk and water may be necessary.

(2) Fat indigestion. Early stage is characterised by constipation with palish, formed greasy stools which do not adhere to the napkin, and tend to crumble. They consist largely of soaps. This is associated with failure to gain weight. A more advanced stage is fat indigestion in which there is vomiting of rancid curds ½—1 hour after a feed and colicy pains. A still more advanced stage is fat diarrhoea, the stools become frequent, sour smelling, greenish yellow in colour and contain mucus and curds. If this stage is neglected the baby will pass either in to a stage of acute gastro-enteritis or into a stage of chronic wasting. Fat dyspepsia is corrected in the early stages by skimming the milk, this removes most of the Fat. Cod liver oil should be omitted. If diarrhoea is present Mellin's food should be given instead

of lactose as it is less easily fermented. In more advanced cases the fat should be completely removed from the milk by converting it into whey by means of rennet. Half cream Cow and Gate milk food may be given.

(3) Carbohydrate dyspepsia. It manifests itself by frequent frothy stools which tend to excoriate the buttocks ; restlessness and colicky pains. Lactose should be omitted and Mellins food (dextri maltose) be given.

Dried milks. Glaxo, Cow and Gate milk foods are sterile and of uniform composition. The casein is rendered more easily digested by the drying process. They keep fresh in sealed tins. One level measure of the dried milk is dissolved in one ounce of water and it gives milk of the same strength as undiluted cow's milk. This may result in over feeding. So dilution may be made in the proportion of $1\frac{1}{2}$—$1\frac{3}{4}$ measures dissolved in $2\frac{1}{2}$ oz of water. This amount is given for each pound of body weight of infant. Lactose is added in the proportion of one level teaspoonful per pound weight as with fresh milk.

Vitamins. Additional use of vitamins is

much more imperative in artificially feed children than those on breast milk. Same directions as given under the heading of breast feeding should be followed.

Other milks.

	Water	Protein	Fat	Carbohydrate	
Buffalo's milk	81·0%	4·3%	8·8%	5·1%	Ca 0.21%
Goat's „	85·2%	3·7%	5·6%	4·7%	Ca 0·17%

Goat's milk is richer than cow's milk and is used successfully for feeding infants like cow's milk. Buffalo's milk is very rich in fat. It is better to remove it. It is much more indigestible.

CHAPTER XIX

Diet in Childhood

Sound feeding of children is very important from the point of prevention of disease and defective growth. From dietetic point of view period of childhood may be divided into two parts :—

(1) Early childhood from 9 month—3 years.

(2) Late childhood from 3 years—6 years.

(1) *Early childhood.* The infant must be weaned about the age of nine months. In India it is a common sight that the child is still on the breast at the age of 1½ years and in rare cases at 2½ years. This practice is extremely detrimental to the health of mother as well as of the child. Delicate children may be continued at the breast up to the first year.

Daily Dietary requirement of children between 9 month—2 years are :—

(1) *Total Protein.* 4 Grammes per kilo of body weight 46 Gm

Animal protein	38 Gm

(2) Fat			46 Gm
(3) Carbohydrates			100 Gm
(4) Total calories			1000
(5) Calcium			1·1 Gram
(6) Phosphorus			1 Gm
(7) Iron			4 mg
(8) Vitamins	A	2000--3000 Units.	
,,	B_1	1 mg or 300 Units.	
,,	C	50—60 mg	
,,	D	1000—500 Units.	

Correct feeding at this stage is very important. Before this period the child was on the breast and was getting practically a sterile food.—the mother's milk and so there was no danger of extraneous infection. With weaning, a change in the nature of diet and in the method of feeding are inevitable which bring in so many psychological and physiological problems for the little human being. The greatest danger is that the child's food may harbour infection or may be unsuitable as it is apt to be more or less an imitation of the food of the grown up. It is at this stage that gastro intestinal diseases

are so common. Acute gastro enteritis, vomiting and diarrhoea take a heavy toll during this period and it is during this period that the fatal disease infantile cirrhosis of liver starts so insiduously.

The diet should be a balanced diet.

(1) *Protein.* The child needs at least 4 grammes of protein per kilo of body weight and from 80—85 per cent of this protein should come from animal sources (38 gms). The best source of protein during this period is milk and other milk products containing casein because it is only from these sources that sufficient amount of first class protein as well as calcium is possible. At least 32 ounces (1000 grammes or 1 seer) of milk per head per day should be the ideal. If milk is not agreeable, curds or fresh cheese from curd may be used.

The second best source of first class protein is eggs. Yolk of one egg may be added to milk Half boiled or poached egg may be used. 1 egg will furnish 7 gms of first class protein. If one egg is to be added to dietary about six ounces of milk which correspond to one egg in protein

value may be cut down from the dietary. But eggs can not replace all the milk in a child's diet Minced meat, scraped cooked meat, pounded fish or meat may be given but there is no advantage over milk and eggs.

(2) Fat. If the requisite amount of milk or egg as given above are taken no extra fat is needed as this diet will supply about 46 Gm of fat daily.

(3) Carbohydrate. Sugar at least one ounce daily are given in milk. The rest of carbohydrates should come from cereals. Right from the day of weaning addition of starch may be made to the diet in small amount which may be increased gradually. This is done by :—

(1) Thickening the milk with whole wheat flour, rice flour etc. or giving.

(2) A little bit of toast or rusk, biscuits, a little porridge, flour pudding.

Indian dietaries. A little Dalia or Khichri well made into paste, Harira, Phirni, Rabri or sago and when the child has cut four teeth at least two upper and two lower, a piece of roti.

mashed or boiled patatoes, sweet potatoe may also be given. Rice may be thoroughly pounded and made in to paste, tapoica and arrowroot may be used. Idli may be given.

The total daily dietary is divided into five portions and given at intervals of 3 hours each.

(4) The above diet should be quite adequate to supply calcium, phosphorus and iron.

(5) Vitamins. A. & D. A. & D. concentrates may be added to the diet. Drops of fish liver oil, Halibut liver oil or synthetic preparations are essential.

Vitamin B1 complex. Yeast or yeast extract or other preparations may be added to the diet.

Vitamin C. orange juice and tomatoe juice are the best preparations during this period and at least juice of one orange daily should be given. Black current purees, rosehip syrup are also good.

(2) Late early childhood. The basic principles are the same as far early childhood. More solid foods enter into the child's dietary during this period.

Relatively more carbohydrates and lesser amount of animal proteins than the period of early childhood are required. The daily dietary requirement of children between 2—3 years are :—

(1)	Total protein 4 grammes per kilo of body weight		56 gms.
	Animal protein (73%)		40 gms.
(2)	Fat		56 gms.
(3)	Carbohydrates		110 gms.
(4)	Total calories		1200
(5)	Calcium		1·12 gm.
(6)	Phosphorus		1·02 gm.
(7)	Iron		4·5 gm.
(8)	Vitamins	A	2000—2500 Units.
	,,	B	1 mg 300 Units.
	,,	C	50—60 mg.
	,,	D	1000—500 Units.

The dietary should be constructed on the same plan as far child during the early childhood. The diet is much more solid and contains a substantial amount of cereal products.

Drinks. Alcohol, tea and coffee should not be given to children. Indian drinks like lemon crush or Shikanjbin, Almond milk or Shardai (without

pepper) or lassi may be given with advantage to children.

Late Childhood

Age 3 yrs—6 yrs. The daily dietary requirement of a child during this period are :—

(1) Total Protein 3.5 grammes per kilo of body weight		65 grammes.
Animal protein (68%)		44 grammes.
(2) Fat		65 grammes.
(3) Carbohydrates		130 grammes.
(4) Calories		1000 C
(5) Calcium		1·2 gm.
(6) Phosphorus		1·1 gm.
(7) Iron		6 mg.
(8) Vitamins	A	2500 Units.
,,	B	1·6 mg or 350 Units.
,,	C	50—60 mg.
,,	D	100—500.

The recommendations of League of Nations are :

A—Protectives foods	Amount	Calories	Proteins in Gms.
Milk	1.65 pints (1000 gms)	660	32

–Protectives foods	Amount	Calories	Proteins in Gms.
Eggs	1·75 oz	70	6
Meat, fish and Liver	1 oz	40	6
Green leafy vegetable	3·5 oz	30	3
Potato	5·25 oz	150	3
Cod liver oil	5 gms	30	
A source of vitamin C.			
B. Supplementary Energy yielding foods :			
Fats	·25 oz	35	
Cereals	4·4 oz	400	17

Total calories 1450 Protein 67

The effects of these balanced diets on children is surprisingly good. In 1938 the London County Council introduced "Oslo" type of meal in school feeding. This consisted of wholemeal bread and butter, 2/3 pint of milk with salads, cheese and fruit. The effect of this meal was described by the Council's Medical Officer as follows : Height and weight in boys were 23 per cent and 18 per cent respectively better, and in girls 39 per cent and 25 per cent better ; The rosy condition of the children was apparent. There was a disappearance of minor ailments and

blepharitis." This meal was styled "the British Health Lunch" or "The British Lunch, for Pep and Punch."

Milligan has suggested an alternative in the following :—

Potatoes (cooked in skins) mashed. 4 oz at least, with $^1/_4$ oz choppled parsly mixed in the mash, $1\frac{1}{2}$ of grated cheese, or meat or fish, and a salad made of whatever salad vegetable are in season, *e. g.*, mustard and cress, water cress, carrot, radish, tomatœ. As a second course 2 oz of whole meal bread and margarine (Vitaminised) should be given, and washed down with 2/3 pint milk or cocoa 2/3 pint, made with whole milk Preferably also the margarine shall be mixed wlth 1/8 oz dried brewer's yeast.

Practically all these suggestions are easily applicable in India. Instead of grated cheese fresh cheese from Dahi or Lassi may be used. Peanut and soya beans may be added to the diet. All the salad vegetables are available and may be taken with chappatis margarine can be easily replaced by vitaminised vegetable product. Well cooked dals, kurhi without pepper may now be added

to children's diets. The use of refined food, preserved and canned fruits, jams and murrabbas should be discouraged and the same remark applies to tea, coffee and alcoholic drinks.

CHAPTER XX

The Diet in Fevers

During fever the body netabolism is increased in proportion to the rise in temperature and hence there is the necessity for increased intake of food. The need for water increases due to this heightened metabolism and in a hot country like ours there is greater urgency to look after the water requirement of the organism during fever if serious effects of rapid dehydration are to be avoided. Under such circumstances the water assumes greater importance than any other ingredient of the dietary. Moreover water dilutes the toxins and washes them out of the system. It is a common mistake in our country that food and water are withheld from the patient during fever. Giving of water especially of cold water is dreaded. This is a great mistake. The first dietary requirement of a fever patient is water which should be given freely if kidneys are functioning normally. Cold drinks are highly gratifying to the patient. As infants and children suffer from dehydration very quickly and as they can not express their need, one should remember

the necessity of giving them water in adequate amounts.

In most cases plain, cold water given in moderate quantity at short intervals is quite sufficient. In prolonged fevers, debilitated persons and infants glucose solution (1 teaspoonful of glucose to one ounce of water) may be given freely. This is especially valuable in gastro intestual derangements with fever. Ordinary syrups, fruit juices, lemonade are given freely. Shikanjbin (Lemon squash) is very good and people dread it unnecessarily because it is sour in taste. Tamarind water is also a refreshing drink. Shardai (Almond milk) may be given but it is always good to omit black pepper from it as it may prove irritating to the stomach. Lassi is very good and the laymen are very timid about it. In hot weather especially when the patient is perspiring very much a little common salt should be added to the water. Alcoholic drinks are not needed and should be avoided unless the patient is addicted to alcohol. There is no advantage in giving aerated water. Excessive use of aerated water may upset the patient as

it causes distension of the stomach which may retard the action of heart.

Barley water, rice water, albumin water, soaps may all be given.

Calories. In fevers body metabolism is speeded up due to rise in temperature as well as due to toxaemia. It is estimated that for every increase in body temperature of one degree fahrnheit, the basal metabolism is increased by 7 per cent. This necessitates a greater intake of calories proportionately. Therefore a high caloric diet is given but the state of digestive organs of the patient should be kept in mind. An adult male weighing 140 lbs needs per day about 1500 calories while in bed (Basal metabolic needs) when such a person is running temperature from 102—103°F his caloric requirements will be increased by 25 per cent, calories required will be C 1900 per day.

Proteins. In fevers there is increased loss of nitrogen from the body, due to destruction of muscles which gives rise to feeling of weakness. So an adequate amount of protein in the diet is essential. But there is no need to go beyond

Sherman's figure needed in health. For an adult weighing 140 Lbs 1 gramme of protein per kilogram of body weight or about 75 grams daily may be sufficient. The best sources of protein are milk and eggs. Curds are (Dahi) very good and fresh cheese prepared from curds is an easily digestible, concentrated form of protein but English type of cheese is indigestible. People unnecessarily dread use of curds in fever. Milk is readily digested and occupies the first place as an article of diet in fevers. Malted milk, Dried milk, condensed milk, butter milk, curds, Lassi may be given.

Eggs may be added to milk to reinforce the liquid diet.

Carbohydrates. In fevers high carbohydrate diet is essential for the following reasons ;—

(1) As the caloric requirement during fevers is high, there is great need for carbohydrates.

(2) High carbohydrate diet "spares" the protein.

(3) During fevers there is great destruction

of body fat and there is danger of acidosis. Carbohydrates are necessary for complete combustion of fat and so help in the prevention of acidosis.

Carbohydrates should be given in an easily assimilable form, cane sugar, lactose or glucose, syrup and honey may be given. Lactose is preferred in cases of intestinal putrifaction. Mashed potatoes, cereals may also be given. For an adult 700—890 grammes of carbohydrates may be required daily.

Fats. As the fever diet is a high caloric diet, addition of fat to the diet is essential because a high caloric carbohydrate diet is likely to be too bulky and so may fail to supply the requisite amount of calories. The best form of fat is in the form of cream (which should be prepared from pasteurized) milk.

Next best form is butter.

Vitamins. Vitamin A & D are best supplied in the form of concentrates. As their deficiency take a long time to arise there is not much urgency for their administration in acute cases

except in children, pregnant and nursing women. But the case of vitamin B. & C. is quite different. These vitamins are water soluble and their deficiency arises quite quickly, vitamin C is given in the form of fruit juices but synthetic preparation may also be required. Vitamin B1 is very essential and a high carbohydrate diet and increased metabolism cause increase in requirement of vitamins of B group. These water soluble vitamins should be given in amounts 2—3 times the amount needed for a healthy person.

Minerals. If there is excessive sweating sodium chloride deficiency may occur and normal saline may be given by mouth or parenterally. Salt may be added to fruit juices or curds or to the diet. In chronic cases iron deficiency may arises.

Diet in Typhoid Fever.

As typhoid is an acute fever of prolonged course, dietetic. management is of utmost importance. Dietetic management in this disease is made complicated by the presence of ulceration of intestines. The principles of dietary are ;

(1) the diet should provide for the increased metabolism of the body.

(2) the diet should be soft, non-irritating to the intestines, easily digested and easily assimilable.

Coleman and Du Bois found that in typhoid the basal metabolism is increased by 40—50 per cent, the average metabolism of a typhoid fever patient being 40 calories per kilogramme per day and he required from 50—80 calories per kilogramme per day to be in equilibrium. This increased metabolism is due to the action of toxins of the disease as well as due to increased temperature. An adult typhoid patient needs from 3500–5000 calories a day so a high caloric diet is given. Formerly the typhoid patient was given only milk and sometimes only the whey which practically meant starvation for the patient. On high caloric diet there is much less body wasting, convalescence is shortened, the mortality is lowered, and the incidence of haemorrhages and perforation is much reduced. Adequate quantity of protein about 80 Gm daily is given. For this purpose milk and eggs are the best form milk plain, or citrated, curds, or fresh cheese of curds. lassi are given with advantage. If there is no objection eggs may be used to fortify

the milk. Cream may also be added to milk to increase the caloric value. Fruit juices and syrups may be given. Bread without the crust, biscuits, Porridge, Pudding made with rice or wheat flour, semolina or jellies may be given, soups, and vegetables in the form of purees may be given Gravy, scrambled eggs may be given. Pounded fish, or minced meat may be given. Butter may also be given.

Soar milk cheese may be given. Fruitades, fruit syrups, Fruit cooktail and fruit foods are given with advantage. Tea, ovaltine or coffee may be given. The feeds are given every two hours and a close watch is kept on patient's digestive organs and stools. Vitamin B complex and C are given liberally. Use of nicotinic acid in typhoid is said to have beneficial effect on nervous symptoms and toxaemia.

For an adult typhoid patient the following quantity of food is required daily :—

(1) Milk 48 oz which provides 960 Calories 48 G. of Protein.

(2) Eggs 2 daily which provides 184C 13 G. protein.

(3) Sugar 2 ounces daily which provides 240C

(4) Butter 2 ounces daily which provides 500C (or corresponding amount of Cream)

(5) Cereal 500 gms which provides 2000 C Protein 30 G.

This is made up into 8 feeds, each feed after every two hours as follows :—

(1) 7 A. M. 8 ounces milk with one ounce of biscuits or one ounce of bread.

9. A. M. 8 ounces milk, tea may be added
1 scrambled egg
1 oz bread
2 ounces porridge.

11. A. M. Fruit juice with sugar.
2 ounces bread or biscuits.

1. P. M. 4 ounces milk, mashed potatoe or rice pudding or flour pudding.

3. P. M. 4 ounces milk 2 ounces bread.

5. P. M. 8 ounces milk with tea or ovaltine

7. P. M. 1 egg, 8 ounces milk with added. Cream, 2 ounces bread.

9. P. M. 8 ounces milk 1—2 ounces biscuits or bread with butter.

Out of Indian dietaries drinks of lemon juice, Shikanjbin, Shardai, syrups, or lassi may be given, milk, curds, Dal soup. Vegetable soups; fruit jellies, jellies, Phirni or well cooked rice well mashed Dalia, Harira, Phirni, egg jelly, egg and milk egg filip, sago or arrowroot may be given. In villages Sattu and Rabri may be used. Chutneys of mint and Corander, pureed vegetables may be given fruit juices and tamarind water may be given.

Rasam may be given. Moree or Conjee may be used.

Use of alcohol in fevers. Alcohol should not be used in fevers except for those who are habituated to it. Alcohol does not act as food according to the latest researches. It is not a cardiac stimulant. It is depressant and gastro intestinal irritant. Glucose drinks, syrup and fruit juices should replace it.

CHAPTER XXI

Diet in disorders of the digestive system.

(1) Inflammatory disease of the mouth and tongue. All irritating foods and drinks are avoided such as acidic fruits, alcoholic drinks, condiments, vinegar. If the inflammatory diseases are manifestation of vitamin B_1 deficiency, the vitamin must be given. Frequently the inflammation is due to B_1, Nicotinic acid or riboflavin deficiency.

(2) Acute Tonsillitis and Pharyngitis. As often there is difficulty in swallowing, liquid or semi solid food is given.

(3) Disorders of the stomach.

Acute gastritis. If excessive vomiting is present, it may be impossible to feed by mouth. Rectal feeding or glucose and saline or amino acid may be given intravenously. Ice is given to suck iced water, iced normal saline with or without glucose may be given. Non-irritating food is given. Fruit juices, alcoholic drinks, condiments are avoided, curds or lassi if sour is avoided. Rice water, barley water, jellies are quite good. As improve-

ment takes places puddings, phirni, porridge may be given. If due to alcohol, alcohol must be forbidden small feeds are given every two hours.

(2) Chronic gastritis. The most common primary causes are excessive use of alcohol, tea, condiments, iced drinks, over-eating and hurried eating without proper mastication and excessive smoking. Strict dieting is necessary. Following articles are avoided :—

Curries, Chutneys, Achars, fatty food, food cooked in fat, heavy indigestible food, meat, alcohol, sometimes fruit juices like Nimbu ki Shikanjbin may also be given up. Small quantity of soft food is given at short intervals. If dental defects are present, they must be corrected.

HYPOCHLORHYDRIA.

The food should be such that it may act as stimulant to gastric secretion *i.e.* rich in condiments, so achars, chutneys, curries, meat extracts are useful. Fat should be decreased in quantity. The food must be well chewed or it may be given in finely divided form.—purees. Diet should be rich in carbohydrates.

Hyperchlorhydria

The diet should exclude all direct stimulants to gastric secretion such as condiments, meat extracts, alcoholic drinks. So the use of achars, chutneys, curries, pickles, sour articles of diet like vinegar are forebidden. The diet should be rich in proteins and fats because proteins 'fix' the free hydrochloric acid and fats check the secretion of gastric juice. The best article of diet in such cases is milk 4—8 ounces given every 2—4 hours. The diet should be poor in carbohydrates as carbohydrates stimulate gastric secretion so sugar and syrups and articles rich in sugar are forbidden.

Defective Motility or "Atonic" Dyspepsia.

In this form of dyspepsia the stomach is unable to pass on its contents to the intestine, therefore the aim of dietetic treatment should be not to overburden the stomach with a bulky diet. Big meals at a time should be avoided. Meals should be small and given at short intervals. Too much fluid should not be taken at a time especially with the meals. Small or moderate amount of fluid should be taken on empty

stomach about half an hour before meal or two hours after meal. Too much cellulose in the diet is also undesirable and therefore green vegetables should be avoided except in puree form. Starchy food should be taken sparingly and potatoes should be avoided as far as possible. Tea, coffee and cocoa should be given up or taken in very small quantities.

Obstruction and Dilatation of the Stomach

In complete pyloric obstruction it is useless to give food by mouth. Parenteral and rectal feeding must be resorted to.

In partial obstruction the diet should be fluid or semi-fluid such as milk, cream, curds, juices broths so that they can pass on easily. In organic cases it may be difficult or impossibe to resume normal diet. In atonic cases, tone may be required after sometime and gradually the diet should be increased and made more solid. The dietary principle is same as for patient with defective motility of the stomach.

Gastric Ulcer

The principles of treatment of gastric ulcer are:—

(1) To keep the acid of gastric juice neutralised so that free acid does not interfere with the healing ulcer.

(2) Not to overburden the stomach with large or indigestible meals.

(3) To keep up the optimum nourishment of the patient so that ulcer heals quickly.

To keep these ends in view small frequent meals of a balanced diet are given at short intervals with antacids to control the acidity of the juice. The most revolutionary changes in the dietary regimen of these cases has been affected by Meulengracht. Formerly gastric ulcer cases were starved like typhoid cases but now the diet is much more liberal and varied like the latter disease. It is possible to treat ulcer cases successfully without alkalies with diet alone. G. E. Dick and C. W. Eisele treated 41 patients of peptic ulcer with diet alone without alkali. These patients were given 1—4 ounces of a mixture of equal parts of milk and cream at hourly intervals during the day and often during the early evening. If cream is poorly tolerated milk alone is given. When all pain was relieved small

amounts of bland foods were added gradually. Vitamins B and C or A were added. Physical and mental rest was enforced. Some cases required atropine. In 8 cases, a few single doses of alkali were given to control pain. Complete relief of symptoms occurred in nearly all cases. In 31 cases, all symptoms were controlled within one week. The craters disappeared in 86 per cent of cases within 75 days.

Haematemesis Cases. The traditional treatment of gastric ulcer patient with haematemesis was :—

(1) Nothing was given by mouth until the bleeding has stopped, as judged by the absence of haematemesis or melaena. After 2—4 days and when the bleeding has been arrested, as judged by absence of haematemesis and by the general condition of the patient. 4 fl. ounces of half strength normal saline was given by mouth every 4 hours for 24 hours. Then milk 1 oz diluted with water 1 oz was given every 2 hours, then milk 2 ounces every 2 hours, gradually was raised to 5 oz every 2 hours. Then diet was gradually added as for an ordinary gastric ulcer case.

Meulengracht advised a liberal dietary from

the very first day of bleeding and obtained a very low mortality of 1 per cent. He argued that old dietary regimen for haematemesis cases was one of starvation which lowered their vitality and delayed healing of the ulcer and mortality under the orthodox treatment varied from 4—22 per cent.

Meulengrachts' Diet

6. A. M. Tea, white bread and butter.

9. A. M. Oatmeal with milk, white bread and butter.

1. P. M. Dinner (meat balls, timbale broiled chops, omlet, fish balls, vegetable grating, meat grating fish grating, mashed potatoes, vegetable purees, vegetable soups, cream of vegetables, stewed apricots, apple sauce, gruel and rice, tapioca puddings). (The patient is allowed to have as much as he wants).

3. P. M. Cocoa.

6. P. M. White bread and butter sliced meats cheese, tea.

Indian diets may be given modified on the principle of feeding by Meulengracht.

6. A. M. Tea or milk, almond milk, white bread or well cooked rice mashed thoroughly and butter Indian Chappati made of wheat flour may be given in the form of purees.

9. A. M. Phirni, Harira with milk, Purreed Chappatis and butter.

1. P. M. Meatballs, Omlet, Fishball grated or Pureed vegetables, potatoes mashed, meat and fish grating, vegetable soups without condiments, gruel, rice, tapioca, sago. Pureed Chappatis. The patient is allowed to have as much as he wants.

3. P. M. Cocoa or tea or almond milk.

6. P. M. Pureed Chappatis or rice and butter, or fresh curds from Dahi well washed to remove the sourness, tea.

Old orthodox gastric ulcer Diets.

There was a time when a gastric ulcer patient was given no food by mouth. He was given rectal

feeding. Lenhartz in 1906 introduced the practice of feeding patients by mouth, starting with very small amounts of an egg and milk mixture and gradually increasing it daily. On the first day 180 calories were given and then gradually increased to 280, 650, 700, 900 1034, 1340, 1418, 1679, 1807, 2024, 2094 or 2234 calories. It is not always necessary to start at the lowest figure and increase daily. One may start with 703 calories or more and increase after 2—3 day according to the patients condition Sippy modified Lenhartz diet is as follows : —

" Three oz. of a mixture of equal parts of milk and cream are given every hour[1] from 7 a.m. to 7 p.m. After one or two days, a soft egg with cracker or bread and butter may be added to one of the forenoon feedings ; 3 oz. of a Cereal, such as well cooked rice, oatmeal, or farina. may be added to one of the afternoon feedings. The cereal is measured after it is prepared. Gradually eggs and cereal are added until at the end of the first week the patient usually is taking each day 3 oz. of the milk-and-cream mixture every hour from 7 a.m. until 7 p.m., and in addition 2 or 3 soft eggs,

one at a time, and 6--9 oz of a cereal, 3 oz. at one feeding. The cereal and egg are given alternatingly. and at the time and in addition to the 3 oz mixture of milk and cream. Custards, cream, soups, vegetable purees, and other soft palatable foods may be substituted now and then for the milk-and-cream feedings. Jellies and marmalades may be gradually added if desired. The patient should be weighed. If desired, a sufficient quantity of food may be given to cause a gain of 2—3 lb. each week.

"At the end of three weeks of the treatment, three small meals, none of which exceeds 10—15 oz. in total bulk, are substituted for three of the feeds, the remainder of which are continued as before. These meals are made up of vegetable purees, potatoes and cooked fruits. Bacon and meat broths are added.

"Upon resuming normal activity or work, the patient continues the same management. He eats the three small meals at home or whereever it may be convenient. Milk and Cream mixed, equal parts, is taken with him to his place of business. A thermos bottle is a desirable

container. From this supply a flat flask may be filled and carried in the pocket."

Sippy's Diet was found to be defective. Fresh vegetables and orange or lemon juice were omitted. The diet was deficient in Vitamin C. This was modified by Hurst as given below :—

Hursts' Ulcer Diet

(1) Every alternate hour from 8 A. M. to 10 P. M. 5 oz. of milk. This may be warm or cold and may be flavoured with tea.

(2) Every other hour, alternating with 1, from 9 A. M. to 9 P. M. a 5 oz. feed which may be made of any of the following :—

(a) Arrowroot, cream of wheat, benger, junket, custard : to any of these red currant, apple or other fruit jelly can be added and the junket may be flavoured with chocolate ;

(b) At least two should consist of a thick soup or semisolid puree of potato, artichoke, cauli-flower or parsnip.

A little sugar may be added to the (a) feeds and a little salt to the (b) feeds if desired.

(3) A rusk with butter should be eaten with three feeds. Small quantities of water or sweetened orange juice and water may be drunk between feeds.

(4) One oz of cream should be added to the 11 A. M., 1 P. M. and 5 P. M. feeds and ½ oz. of olive oil should be taken before the 9 A. M., 2 P. M. and 7 P. M. feeds.

(5) One teaspoonful of mixture A (see below) should be added to each milk feed, and one or more additional drachms of emulsio magnesiae, according to the state of the bowels, are taken immediately before.

(6) One teaspoonful of mixture B (see below) before the 8 A. M. and 3 P. M. feeds and two teaspoonful befor the 10 P. M. feed.

(7) One teaspoonful of tribasic magnesium or calcium phosphate with a little water after the 3, 7 and 10 P. M. feeds. An extra powder should be taken after any other feed during the day or night if the slightest indigestion or heart burn occurs.

(8) The mouth should be washed out after each feed and the tongue thoroughly cleaned by scraping with a spatula night and morning.

(9) No smoking should be allowed during the strict treatment.

(10) During the night the patient should have a feed with mixture A by his bed side so than whenever he wakes whether in pain or not, he can take a feed. This can be repeated at intervals of an hour or more whenever he is awake during the night.

Mixture A.

R/.	Sod. Citratis		15 grs.
	Aquam	ad	60 mims.

Mixture B.

R/.	Atropine	Sulphats	1/200 grs
	Aquam	ad	60 mims

Articles allowed for gastric ulcer patients :—

(1) Milk, Cream, butter, Dahi not sour, fresh cheese from Dahi which is washed to get rid of sourness.

(2) Eggs.

(3) White bread.

(4) Jellies, vegetable jellies, Honey golden syrup.

(5) Weak tea and Cocoa with plenty of milk.

(6) Mashed potatoes, well cooked rice, pudding.

(7) Pureed vegetables.

Formerly tea was allowed to peptic ulcer cases. But now it has been found that beverages containing caffeine stimulate gastric secretion. Like alcohol caffeine works synergistically with histamine. Tea, coffee should be restricted to a minimum in ulcer cases and if small amounts are allowed they should be taken with cream and sugar. (J. A. Roth et al).

Articles of diet forbidden for cases of gastric ulcer.

(1) Alcoholic drinks.

(2) Mineral waters.

(3) Brown Bread.

(4) Coffee.

(5) Fish with fine bones such as herrings, salt fish and salmon.

(6) Fried foods.

(7) Stewed fruit, tinned or raw fruit.

(8) Jam, peel of marmalade, currants, dried fruits nuts and seed,

(9) Meat, meat soups, extracts or broths.

(10) Marmite, pickles, chutneys, Achars, rich sauces, vinegar, condiments or added salt.

(11) Suet puddings and pastry, sweats.

(12) Vegetables and salads of all kinds specially with stalks pips seeds or hard fibrous parts.

(13) All articles rich in cellulose or rhoughage.

(14) Smoking.

Recent work in the management of peptic ulcer cases has stressed the importance of diet above all other forms of therapy. In fact alkalies, antispasmodics and sedatives are not required. V. J. Gianelli and V. Bellafiiore observed two groups of patients at Hammond General Hospital, one group received the army convalescent ulcer diet only, the other group received a Sippy type of dietary regimen with alkalies, antispasmodics

and sedatives. Both groups fared equally well. 478 patients were given the following convalescent ulcer diet :—Beverages made with milk ; toast white or grahm bread ; butter moderate amount ; cereals, refined cooked or uncooked. Cheese, cottage, cream and bland ; desserts, bland such as Custards and pudding ; eggs, any style, except fried ; meat, scraped ; fruit cooked and strained ; soup, creamed and pureed only ; Vegetables, strained and pureed only. No nuts, salads, sweets or condiments are permitted. Tender meat or fish or foul usually ground was served once or twice daily from the beginning orange and tomato juices were served. Raw bananas were served. Soft vegetables such as summer squash, stewed tomatoes, carrots, beets, spinach, green peas, tender string beans, and asparagus tips were served without straining or pureeing. Seedless jams and nutless candy were permitted.

No attempt was made at alkalinization as a part of the treatment and consistent sedation was not utililized in any case. Alcohol was forbidden but tobacco was allowed. All cases except 40 out of 478 patients improved satisfactorily on this diet. These forty cases complained of persistent

abdominal pain and all except one showed positive X-ray evidence of active ulcer. These patients were given a special ulcer diet with vitamin "U" which consisted of in additions to the regular convalescent ulcer diet ;

Breakfast :	Eggs 2, cooked 2½ minutes, Butter, 2 pats (20 gms).
10. A. M.	Eggnog 1/3 liter.
Dinner :	Butter 1 pat (10 gm). Salad 1 serving with special olive oil dressing.
3. P. M.	Peanut butter sandwich (with or without jelly), 30 gm, peanut butter (smooth). 1 pat butter (10 gm) Eggong, 1/3 liter.
Super.	Butter 1 pat (10 gm).
8. P. M.	Eggong, 1/3 liter.

The eggnog formyla : 4 eggs (200cc) ; sugar, 30gm ; Vanilla, 2cc ; 20 per cent cream 200cc milk 550 cc.

Salad may contain lettuce, broccoli, watercress, romaine, parsley, tomato, avocado (all fresh) Salad dressing recipe : lemon juice 160 cc. ; olive oil 320 cc. ; salt 10gm ; sugar 30 gm.

Caloric value of this diet is about 4200 calories and contains approximately 150 gm of protein, 450 gm of carbohydrates and 250 gm of fat.

The following medicaments known to contain vitamin "U" were included in the treatment.

(1) Cerophyl tablets made from green grass stalks in a dose of 2·5 gm three times a day after meals and 2·5 gm at bed time.

(2) Hog stomach extract in the form of ventriculin in a dose of 15 gm three times a day.

(3) Bile salts (Bilron) half a gram three times a day after meals as they had been shown to be effective in enhancing the activity of vitamin "U" by promoting the absorption of the fat soluble substance. No other form of treatment was given. The average duration of treatment was about 1 month. Out of 40 cases, 3 did not carry out the treatment All the 37 showed some improvement and 34 patients obtained complete relief. X-ray studies showed negative findings or only a slight deformity. Approximately 80 per cent gained 5 lbs or more during treatment.

Intestinal Disorders.

Acute Appendicitis. Sometimes cases of acute

appendicitis are treated on medical lines. Dietetic treatment in such cases becomes of paramount importance. This is best carried out by stravation treatment of Ochsner as follows :—

(1) No food or cathartics by the mouth.

(2) Lavage if nausea and vomiting occur.

(3) Nutrient enemata.

(4) Water by the rectum.

After the patient is free from pain and normal for four days, fluids are gradually given by the mouth.

Diarrhaea

Acute Diarrhoea. All food by mouth is stopped for 24 hours. The chief danger is dehydration. Small amounts of water or normal saline are given by mouth every 1—2 hours. If dehydration is severe parenteral fluid may be required.

Gradually as the process becomes less acute barley water, rice water, fruit juices, glucose solution and syrupus are given. Milk is badly tolerated. Acidulated milk or citrated milk or diluted milk may be given. Curds (Dahi) are better than milk. Gradually milk may be thickened

with cereals. Flour pudding, well cooked rice, phirni, or Harira may be added. Soups, jellies and arrowroot or sago may be given. Whey is useless and there is no advantage in abumin water. Apple or bannana diet is useful. These may be taken raw or cooked, well mashed and grated.

Chronic Diarrhoeas, It may be either

1. Fermentative
2. Putrefactive or
3. Fatty diarrhoea.

Fermentative diarrhoea is due to fermentation of carbohydrates in the diet. The stools are pale yellow in colour, frothy, sour smelling and acid in reaction. Diet should be easily digestible and all carbohydrates are stopped for a few days. Glucose water or tea and coffee may be given. cream, eggs jelly, fish, fowl, butter, milk puddings and toast may be given. Vegetables and fruits containing rouhage are contra-indicated.

A banana diet or apple diet is also useful. 4—5 pounds of each are given daily. Apples are peeled and grated or thoroughly masticated. If

there is no improvemənt in a day or two it is not likely to do any good.

(2) Putrefactive Diarrhoea. This is a more serious condition. The stools are dark in colour, foul in smell and alkaline in reaction. This is due to putrefaction of proteins in the diet.

Diet. All diet should be stopped for 24—48 hours. Barly water or glucose water alone is given. Milk, malted milk, butter milk or Curds are suitable. 2—3 pints being giving daily. Gradually milk pudding, cornflour preparations, biscuits, toast and butter can be added. Protein foods like meat, fish and eggs and foods containing cellulose such as vegetables, salads and fruits are forbidden. Apple diet or banana diet may also succeed.

(3) Fatty diarrhoea. This is seen in non-tropical sprue, sprue and coeliac disease. The stools are large, greazy and offensive.

Diet. Fat should be reduced to minimum. Fresh skimmed or dried skimmed milk or butter milk may be used. Milk may be thickened with cornflour and later on other starchy foods meat extracts, lean meat and white fish may be given.

As improvement occurs more fat may be added. Fresh or cooked fruits are useful.

Chronic Diarrhoea. In chronic diarrhoea, dysentery or colitis diet rich in cellulose is cut down. Low residue diet is indicated. It consists of :—

(1) Milk and cream, or curds and butter.

(2) Eggs, boiled, or scrambled but not fried.

(3) White bread, rice, cornflakes, patent barley.

(4) Honey, golden syrup, jellies, mashed potatoe, milk pudding.

(5) Orange or Lemon juice, Bananas, apple, other fruits and vegetables with low cellulose content given in puree form.

Following articles are forbidden :—

(1) Whole grain flour or dishes.

(2) Brown bread, wholemeal bread.

(3) Fish with small bones such as eels, herrings sardines.

(4) Fried foods.

(5) Acid fruits, tinned or stewed fruits.

(6) Achars, chutneys, murabbas, pickles, jams, peel marmalade, dried fruits and nuts.

(7) Salads, vegetables, meat except chicken or tender meat.

Coeliac Disease

It is a disease of infants characterised by difficulty in the assimilation of fat. Fat soluble vitamins A and D also suffer absorption and hence their deficiency arises. The dietary indications are restriction of fats and carbohydrates. Dried milk, separated milk, sour milk, acidulated milk, curds, white of egg, minced lean meat, fruit juices and green vegetables are given. Vitamin A and D are given.

In coeliac disease a high protein diet is given. A. C. Adamson et al used proteolysed beef in the treatment of coeliac disease with success. This form of therapy provides a concentrated solution of first class protein and in this way equivalent of 1 lb of beef a day can be taken by a young child over an indefinite period. 'Banana cure' was a failure in one case.

Sprue and Coeliac Disease in Adult.

In sprue there is disturbance of absorption

of fat and of digestion of carbohydrates. Diet rich in protein is given. This may be (1) Milk Diet (2) meat Diet (3) Mixed Diet. In sprue the proportions of fat and carbohydrates are reduced by at least two-thirds. Diet must be rich in vitamins. (1) Milk diet. Skimmed or separated milk is used. Feeds are given every two hours. Milk is sipped slowly citrated milk or peptonized milk, butter milk may be used. Three pints of milk are given at the start which is gradually raised to 5 pints. Glucose is added to milk. Orange Juice is also given. Vaids treat sprue which they call sangrahni, with diluted curds from which fat has been removed, called (Chhachh) : The patient is given nothing else but this diluted curds. The treatment is successful.

(2) Meat diets. High meat diet is not so suitable in India. These have been arranged by N. H. Fairley as given below :—

High—Protein Diet 1.

(Calorie Value 1005)

Carbohydrate 73 grammes, Protein 72 grammes. Fat 45 grammes.

High—Protein Diet 2

(Calorie Value 1756)

Carbohydrate 128·5 grammes, Protein 128 grammes. Fat 77 grammes.

High—Protein Diet 3

(Calorie Value 2317)

Carbohydrate 185 grammes, Protein 164·5 grammes, Fat 97 grammes.

High Protein Diet 4

(Calorie Value 2782)

Carbohydrate 223·5 grammes, Protein 179·5 grammes fat 116 grammes.

High Protein Diet 5

(Calorie Value 3557)

Carbohydrate 375 grammes, Protein 199 grammes, Fat 123 grammes.

(2) Another dietetic regime consists chiefly of milk and it gives very good results.

Diet First Week

(1000 Calories)

Three pints (60 oz) of Cow's milk or Benger's food in 5—oz feeds at two honr intervals : toast ;

"pulled bread ;" " Hendebert " rusks ; or digestive biscuits with a scrape of butter.

Diet 2 Second Week.

(1900 Colories.)

Three pints (60 oz) of Cow's milk or Benger's food as in No 1 ; rusks, toast, sago 6 oz Liver soup, 12 oz in two feeds of 6 oz each, one lightly boiled egg, weak tea or tea infused with milk 8 oz.

Diet 3 Third Week Onwards.

(3900 Calories)

Breakfast. Porridge, gruel, 1 egg, toast and weak tea.

11. a. m. 10 oz milk, Spruelac or Benger's food.

Lunch. Liver Soup 12 oz minced Chicken 6 oz. Spinach or Cauliflower 3 oz Sago or Semolina 6 oz baked apple or mashed banana 6 oz.

Tea. Toast tea ; Maderia Cake, sponge Cake, digestive biscuits 3 oz.

Dinner. Brain or Sweetbread 4 oz. calves

foot Jelly 3 oz arrowroot, Sago or tapioca 8 oz.

Chronic Pancreatitis.

Diet poor in fat is given. eggs are forbidden meat fish, vegetables and fruits are given.

Constipation.

Constipation is delay in the evacuation of faeces or delay in the passage of faeces through the intestines. The former is called dyschezia and diet is of no use in this condition. Delay in the passage of faeces through the intestines or intestinal constipation may be due to the following causes :—

(1) The small bulk of faeces.

(2) Spastic condition of the bowel wall.

(3) Atonic condition of the bowel wall.

(4) Obstruction.

(1) The constipation due to small bulk of faeces.

(*a*) It may result from insufficient food.

(*b*) Diet poor in residue. In such cases diet rich in cellulose or rhoughage should be given as rhoughage stimulates the intestinal activity. Green vegetables, wholemeal bread, wholemeal cereals and fruits are rich in cellulose. Leafy vegetables such as spinach (Palak). cabbage (Bundgobi), rapeseed leaves (Sarson ka Sag), curry leaves (Gandhela), Fenugreek leaves (Methi ka Sag), Lettuce, Amaranth (Cholai), Leaves of Radish (Muli), and Cauliflower (Gobi), Tomatoes, Ladies finger (Bhindi), Cucumber, Brinjal, Turnip, Carrots.

Porridge or Dalia, Khichri, wholemeal Chapatis are taken.

(*c*) From insufficient fluid intake. Plenty of fluid is taken and a tumblerful of water as first thing in the morning is especially useful.

(*d*) From excessive loss of fluid in diseases like diabetes mellitus, from excessive sweating in hot weather, or excessive

absorption from the colon. Fluid loss is replaced by giving more fluid.

(2) Constipation from spastic condition of the bowel.

In such cases a low residue diet given as the rhoughage is harmful and will increase the constipation by stimulating the intestine to spasm. So all the articles rich in cellulose are avoided. Vegetables and wholemeal bread, brown bread, wholemeal porridge are forbidden. Dried fruits, nuts, with edible pips and skins such as figs, etc. are forbidden. White bread, milk, syrups. butter, cream meat, strained fruit juices, jellies, sugar and cheese are allowed. Large amount of fat in diet is especially useful.

(3) Atonic condition of the intestines. If due to organic causes it is helped by the diet rich in cellulose. Plenty of fluid is taken and diet should be rich in fat.

(4) Obstruction. Diet cannot help such cases and the cause must be removed.

Diseases of Liver and Gall Bladder.

Billiousness or chill on the liver. Fatty articles

and alcoholic drinks are forbidden. The best diet consist of fruits, separated or skimmed milk, butter milk or curds. Condiments are also avoided. Soups, broths, small amounts of farniceous food are given.

(2) Jaundice. As bile helps digestion of fat and bile is not entering the intestine freely, fat is forbidden in jaundice. While milk should not be given. Skimmed milk, separated milk, butter milk or lassi are given. Too much of protein is also bad. Eggs are not given. Best diet consists of vegetables and fruit. Plenty of fruit juices should be given. Dextrose drinks and syrups, meat soup, vegetable soup are good. As there is catarrh of the stomach and duodenum also, irritating and coarse food is avoided. Fried articles are not given.

(3) Cirrhosis of liver. This disease is common among the poorer classes of South Africa and India. It is ascribed to a faulty diet. Diet rich in cereals, poor in vegetables and fruits, milk, meat and eggs has been found to predispose to cirrhosis. Infantile liver is due to faulty feeding. The children are given too much of

sugar and starch. It has been found that sulfur containing amino acids as cystine, methionine protect the liver against damage by poisons. Best results are achieved by giving 2·5g methionine daily and preferably 3g. or one pint of milk a day during arsenical therapy (Beattie et al). Miller and Whipple (1942) observed that in protein-depleted dogs chloroform anaesthesia was followed by fatal liver damage. Probably a protein deficient diet especially that poor in milk which is rich in methionine, predisposes the liver to toxins and so jaundice or cirrhosis results.

In cirrhosis of liver, alcohol and condiments are forbidden. The best diet is that rich in milk and fruits. All irritating articles are avoided, moderate amount of carbohydrates may be givən. Diet should be rich in vitamins.

Dietary Treatment. Cirrhosis of liver is now looked upon as a deficiency disease. In 1941 Patek developed a new dietary regimen for cirrhosis of liver which has given unexpected results. This diet is rich in protein and ample in carbohydrate and fat, calories 3600 protein 139 gm, fat 175 fat, and carbohydrate 365 gms. The diet consists largely

of meat, milk, fruit and green vegetables. Meat is served twice daily: Milk five times daily—three times with meals and twice with 25 gm of powdered brewer's yeast. If yeast is not tolerated, oral liquid yeast concentrate is given. In addition, thiamine hydro-chloride (5mg) is injected intra-muscularly every day, and concentrated liver extract (5cc) twice weekly. Fluids are allowed upto 2000 c. c. daily. Too rigid restriction of salt and water may prove harmful to these patients by precipitating symptoms of hypo-chloremia and dehydration. 54 cases were treated on this plan. 22 died, 12 improved partially, 22 showed signs of "clinical recovery" by :—

(1) gain in weight and strength permitting the patient to resume his previous activity.

(2) Loss of ascites, edema and jaundice without recurrence.

(3) Changes in serum proteins

60 per cent. of the treated patients, in contrast to only about 7 per cent. of the control group, experienced the spontaneous disappearance of

ascites. The period of survival after the onset of ascites was

At 6 months	57%	in controls &	72%	in treated cases	
At 1 year	37%	,,	57%	,,	,,
At 2 years	22%	,,	45%	,,	,,

Far superior results might be expected if the dietary treatment is instituted earlier. Snell used a nutritious diet supplemented with vitamins The diet was high in carbohydrates (500 gm), low in fat (about 60 gm) and rich in proteins not derived from meat sources (110 gm) providing roughly 3000 calories per day. The protein was derived from vegetables, milk and egg white. Vitamins were added and bile salts 0.3—1.0 gm given with each meal to facilitate absorption of fat soluble vitamins. The results were excellent in 44 per cent. of the entire group.

Diet is supplemented with brewer's yeast 30–50 gms a day, and other vitamins at least twice in amount estimated for normal adult. Where hemorrhagic tendencies were present vitamin K was given orally or par enterally.

(4) Gall bladder disease. In cholecystitis and

cholelithiasis low cholestrol diet used to be prescribed because it was believed that the level of cholestrol in the blood and bile was influenced by the intake of cholestrol in food. Latest researches have proved the hollowness of this hypothesis. Nancy Gough investigated the effects of high and low cholestrol diets on the cholestrol content of the blood and bile. No direct correlation between the intake of cholestrol and its level in the blood and bile was found. These observations give no support to the contention that foods rich in cholestrol should be prohibited in the diet of patients with cholecystitis and cholelithiasis. The exclusion of butter, fat, eggs and liver from the diet of patients with diseases of the biliary tract is based essentially on the hypothesis that gall-stones are formed from cholestrol, and that a reduction in the intake of cholestrol accordingly reduces the liability to gall-stone formation. Such a low-fat, low-cholestrol diet is unphysiological because fat is the natural stimulant to biliary contraction and drainage, and has the further disadvantage of being unpalatable, and low in fat soluble vitamins.

As taking of meals stimulates the flow of bile

frequent small meals are taken Large quantity of water on emply stomach is also useful. A tumblerful of water as first thing in the morning will help in making the bile thin.

CHAPTER XXII

Diet in Diseases of the Circulatory System

(1) Anaemias.

(*a*) Microcytic anaemia. Food rich in iron is given. Diet rich in animal proteins, fruits and vegetables is necessary.

(*b*) Pernicious anaemia or tropical macrocytic anaemia. Minot and Murphy, Castle and others gave liver to pernicious anaemia patient. Half a pound of raw or cooked liver was required daily. Diet rich in proteins and vitamins should also be given. Extract of Hog's stomach is equally effective and much smaller doses are given by mouth. Tropical macrocytic anaemias are deficiency anaemias and are treated successfully by a diet rich in animal proteins and vitamins. Yeast, or marmite is specially useful. All macrocytic anaemias respond rapidly to parenteral liver therapy.

(2) High Blood Pressure. Alchol, tea, tobacco are forbidden or greatly curtailed. During the

sudden rise pure milk diet is very useful. The diet is regulated bulky meals are avoided. The number of meals per day is also reduced. Drinking of too much fluids at a time is also avoided. Use of Sodium chloride in the diet is stopped or greatly curtailed. Best diet is lacto vegetarian. Meat, meat soups and broths, fatty foods, fried articles are forbidden. Fruits and eggs may be given

(3) In heart disease the aim of dietetic treatment is to reduce the strain on the heart. "In the presence of heart failure there is evidence to indicate that a rapid reduction (in 2–3 weeks) in weight of approximately 10 per cent. from a normal or underweight level, exclusive of oedema fluid, is accompanied by considerable improvement in the functional state of the vascular system. When the lower weight level is reached, a diet which maintains the weight likewise maintains the beneficial effects on the Cardio-Vascular state for at least several months." (D. Samuel H. Proger) Therefore :—

(*a*) the diet must be of low caloric value below maintenance. For this purpose fat and

carbyhydrates are cut down. Protein, minerals and vitamins should be in normal amount. If edema is present Sodium chloride is cut down.

(*b*) Food should be easily digestible. Bulky food is avoided. Easily fermentable articles are avoided.

(*c*) Meals. Should be small and repeated at short intervals. Amount of fluid taken is greatly reduced not more than 30–40 ounces a day. Aerated drinks are avoided, the liberation of gas in the stomach cause distension and retard the action of heart. Decrease of fat in the diet will help the stomach to empty itself more quickly. Green vegetables, turnip, carrots, peas, beans, lentils, dals, fruits, potatoes, sugar, jam and soups which cause flatulence are avoided.

(4) Congestive Heart failure. The meals should be taken dry. The amount of fluid taken daily is greatly reduced about 30—40 ounces a day. Salt is also prohibited. Aerated drinks are avoided. The food should be easily digestible and small quantities are taken at short intervals. Over loading of the stomach must be avoided. Green

vegetables, turnip, carrots, peas, beans, lentils, dals, fruits, potatoes, sugar, jam and soups and articles likely to cause flatulence must be avoided. The diet must be rich in vitamins B_1 and C.

CHAPTER XXIII

Diet in Obesity and Diabetes Mellitus

Obesity. Banting-cure. The diet consisted of :

Breakfast. 4—5 oz. of beef, mutton, kidneys broiled fish, bacon or any cold meat except pork ; a large cup of plain tea, and a little biscuit or 1 oz. of toast.

Dinner. 5—6 oz. of any lean meat or fish any vegetable except potatoes, 1 oz. of dry toast, some fruit out of a pudding, any kind of poultry or game and 2—3 glasses of good claret, sherry or madeira.

Tea 2—3 oz. of fruit, a rusk or two and a cup of plain tea.

Supper 3—4 oz. of meat or fish as at dinner and a glass or two of claret. At night a glass or two of claret or sherry. The approximate value of this diet excluding alcohol is Carbohydrate 80 grammes, protein 84—105 grammes and fat 80—100 grammes. Calories 1480—1650.

Banting himself suffered from an extreme

degree of obesity and treated himself with the above regimen. He lost 35 lb of body weight in 38 weeks. Translated in to the terms of Carbohydrates, fats and proteins this diet consisted of Carbohydrates 80 gms, fats 80—100 gms, proteins 84—105 gms with a caloric value of 1500—1650C. The chief defect of Banting diet is a very low amount of carbohydrates. Persons using this diet complain of great fatigue and sense of tiredness and these symptoms are due to hypo glycaemia as explained by the researches of Banting and Best on insulin. Every normal man produces a certain amount of insulin which requires at least 125—150gms of carbohydrates daily to prevent hypoglycaemia. The principles of treatment of obesity with diet are :—

(1) Supply the minimum amount of carbohydrates compatible with a sense of well-being 125—150 gms daily at least. This will supply about 410—615 calories.

(2) As the person to be treated has depots of surplus fat which is aimed to be got rid off his fat in the diet must be curtailed. The usual amount of 100 gm of fat daily, which is the

amount present in Banting cure can be reduced easily to half or 50 gms a day. This will yield 450 c a day.

(3) The person must be supplied with the minimum amount of protein sufficient for the daily wear and tear of the body tissues. This is from 35—40 gms a day. This will yield 150—175 calories a day. The total caloric value of the diet being 1000—1250 c a day.

(4) Vitamins should be added to the diet in the form of concentrates if any deficiency is expected to arise.

In some cases further reduction may be necessary. Carbohydrates can be reduced to the lowest limit of 100 gms a day and the fat is reduced to 25—30 gms a day. No reduction is made in the proteins in the diet otherwise nitrogen equlibrium of the body will be upset. In order to over come the feeling of hunger bulky food consisting of leafy vegetables is selected and the diet rich in vegetables and some quantity of milk to supply the adequate amount of proteins and calcium is the best. Plenty of water should be taken. Sugar and alcohol are avoided.

Diabetes Mellitus

In a normal human being the carbohydrate metabolism is maintained by a balance between the carbohydrate of the food and the endogenous insulin of the body. In a person suffering from diabetes mellitus, insulin secretion by the pancreas is not enough to metabolise the carbohydrates in the food with the result that hyperglycaemia and ketosis results. In such a person either more insulin should be supplied to the body by way of injection or the carbohydrates in the diet be cut down to the tune of endogenous insulin to get rid off hyperglycaemia and ketosis. Sometimes carbohydrates cannot be restricted too much as there will be a danger of ketosis and such cases must be given insulin.

At one time, early in the evolution of dietetic treatment it was taught to stop all carbohydrates from the diet and give only fats and proteins. This proved very dangerous as early coma was the result and death followed.

Allen started the treatment of diabetes mellitus cases by the principles of total diet

restriction and under nutrition. It was found by experiments on dogs in 1912 that a dog which had been made diabetic by removal of a portion of its pancreas could be kept sugar free and healthy, though thin, by an under nutrition diet low in calories. It could be made diabetic again by raising the total calories either in the form of carbohydrate, protein or fat and its general condition deteriorated along with the re-appearance of the sugar. If diet was again decreased in calories after starvation the animal was again made sugar free and healthy. So Allen's method was ;

The patient is starved until no sugar is excreted in the urine. Then 10 grammes of carbohydrate in the form of green vegetables are given with the minimum of protein and fat and increased the carbohydrate by 10 gm every day until sugar appeared in the urine. Now one day of starvation was given in order to clear up the glycosuria. Protein is then added until it is equal to 1·50 or 1 gm per kilo and finally fat is slowly added to the diet, in order to raise the caloric value to about 1800 calories. If sugar is passed a starvation day is given. He

always aimed at keeping his patients somewhat uuder weight and sugar free on an under nutrition diet.

This treatment was successful in mild and moderately severe cases but severe cases died a death of starvation because the diet on which they could keep sugar free was insufficient to maintain their nutrition.

Ladder Diet. The underlying principle is same *i. e.* under nutrition. The prolonged starvation is eliminated. At St. Bartholomew's. Hospital the following plan is used. The patient is starved for 2 days as before, but whether he is passing sugar or not he is given 5 eggs, 50 gms butter and 300 gms green vegetables on the third and fourth days.

If he is still passing sugar, a further 2 day's starvation is prescribed. If urine is sugar free on the fifth day, 50 gms of meat are added for 2 days at midday. On the 7th and 8th days 50 gms of meat (ham) are added to the tea meal and one egg is decreased on the 9th and 10th days 50 gms of meat (bacon) are added to the

breakfast and one egg is decreased. If the urine is still sugar free 100 c c of milk are added on the 11th and 12th days; on the 13th and 14th days 15 grammes of bread are added in two portions and on 15th and 16th days another 15 gms of bread are added to two other meals, so that the effect of sugar is spread over four meals in the day. Provided no sugar is excreted another 15 gms of bread are added. On the 19th and 20th days if the acetone bodies are quite small in amount 25 gms of fat are added and again on the 21st and 22nd days. This makes a diet of Carbohydrates 37 gms, protein 53 gms fats 180 gms calories 1800 which for a man of 60 kilos is 31 calories per kilo with 0·57 gms of protein per kilo. If the urine is sugar free and the disease is of some standing, the patient is now allowed to get up : but if the disease is of recent origin, the patient is kept in bed at this level for another 4 weeks, so as to rest the pancreas as much as possible. If sugar is passed, a starvation day should be ordered and less carbohydrate given. If sugar is excreted quite early on the ladder diet, the patient should be kept at the bottom of the ladder and only allowed to climb up

slowly. If sugar is passed on quite a low caloric diet, alcohol should be substituted. An adult can burn 2 ounces of absolute alcohol in the day and a diabetic can use it without excreting sugar (Leyton). If the patient has a high sugar tolerance and can eat one ounce of bread without passing sugar, the following list of sugar foods with their equivalent sugar values will be of assistance.

> One ounce bread=2½ ounces of potatoes=2 ounces cooked rice=4 ounces of cooked porridge=3 ounces of cooked green peas =2½ ounces of bananas=3 ounces of grapes=4 ounces of oranges=3 ounces of almonds.

(after Price)

2. *The Maintenance Diets.*—In this method of treatment no fast is given. The patient is given from the very start of treatment a diet sufficient for the caloric requirements of the patient. When the patient is treated in bed all the twenty-four hours his caloric requirements are expressed by his basal metabolism which are equal to 25 calories per

kilogram per day. This diet is called a basal diet. For a sedantry worker 5—10 calories per kilogram per day and for an active worker 15—25 calories more per kilogram per day are added to the basal diet. This diet will just meet the requirement of the patient and is called a maintenance diet. The best example of maintenance diet is furnished by the Modern Diet of Line Ration Scheme of Lawrence. It embodies the following four principles :—

(1) It must be a maintenance diet.

(2) It must contain sufficient carbohydrate to prevent ketosis utilisation of 100 gm. carbohydrate a day by the diabetic with or without insulin is enough to prevent ketosis however much fat is used.

(3) It must satisfy the patient in quantity and quality.

(4) It must be accurate, simply to calculate and varied.

THE "LINE-RATION" DIET SCHEME †

One black portion added to one red portion=one Line-ration.

Carbohydrate Foods (containing Sugar or Starch) *Black Portions* (10 *gm. C.*)	oz.
Rice, Sago, Tapioca (raw)... ...	$\frac{2}{5}$
Biscuit, Toast or Breakfast Cereals; Flour Oatmeal, Macaroni (all dry); Jam or Marmalade	$\frac{1}{2}$
Bread (all kinds)	$\frac{2}{3}$
Potato, Peas or Beans (dried or tinned); Banana or Grapes; Dried Apricots (stewed)	2
Parsnips; Ripe Greengages; Prunes (stewed)	3
Raw Apple, Pear, Cherries, Gooseberries, Plums, Damsons, Orange (skinned); Young Peas or Beetroot	4
Peach or Apricot or Blackcurrants (ripe); Greengage (stewed); Broad Beans	5
Strawberries; Stewed Pears, Damsons or Plums	6
Milk (also contains 1 Red); Raspberries or Melon (ripe); Blackcurrants (stewed)	7
*Apples or Cherries (stewed): Carrots or Leeks	8

***Red Portions* (*Protein and Fat*)**
7½ gm. Protein and* 9 *gm. Fat

One Egg.
Bacon or Ham (both lean) 1 oz.
Kidney 1 oz. and Fat ¼ oz
Liver 1 oz. and Fat ¼ oz.
Tongue (tinned or fresh) 1 oz.
Tripe or Sweetbreads 1¼ oz. and Fat ¼ oz.
Lean Beef or Veal 1 oz. and Fat ¼ oz
Lean Lamb or Mutton 1 oz. and Fat ¼ oz.
Lean Pork 1 oz.
Chicken or Pigeon 1 oz. and Fat ¼ oz.
Duck 1 oz.
Pheasant, Grouse or Partridge ¾ oz and Fat ¼ oz
Rabbit or Hare ¾ oz. and Fat ¼ oz.

*Jerusalem Artichokes ; Loganberries Blackberries (stawed) ... 10
*Grapefruit (in skin) ; Tomatoes ; Reb Currants 12
*Onions, Turnips or Radishes .. 14

Negligible Starch Content in Average Helpings of—

Asparagus, Green Artichokes, French Beans, Brussels Sprouts, Cabbage Cauliflower, Celery, Cranberries, Cress, Cucumber, Egg Plant Endive, Stewing Gooseberries, Greens, Horseradish, Lemons, Lettuce, Marrow Mushrooms, Radishes, Rubarb, Salsify, Scarlet Runners, Seakale, Spinach.

Crab or Lobster $1\frac{1}{4}$ oz. and Fat $\frac{1}{4}$ oz.

Herring 1 oz. and Fat $\frac{1}{4}$ oz.

Kipper 1 oz. and Fat $\frac{1}{4}$ oz.

Salmon 1 oz. and Fat $\frac{1}{3}$ oz.

Sardines 1 oz.

White Fish (all kinds) $1\frac{1}{4}$ oz. and Fat $\frac{1}{8}$ oz.

Cheese 1 oz.

Milk 7 ozs. (also contains 1 Black)

Fats are Meat Fats, Suet, Dripping, Butter, Margarine, Olive Oil ; Thick Cream in twice the amount stated for other fats.

Extras of no food value : Tea, Coffee, Soda Water, Bovril, Oxo, etc., ordinary condiments and flavourings.

Doctor's Prescription :—

Rations per day :	15 *Blacks*	10 *Reds*	*Insulin*
Breakfast :	5		12
11 a.m.			
Dinner :	3		
Tea :	2		
Supper :	5		8
Bed time.			

† These two pages are published as a convenient card by M/s. H. K. Lewis Co
*Half potrions of these are usually enough.

Treatment with Line Rations This scheme is best suited for mild cases. To start with these cases are put on 10 Lines which will contain 100 gms carbohydrate, 75 gms proteins, and 90 gms of fat and unlimited green vegetables. The carbohydrates are spread equally over the three or four meals. The patient can go on with his ordinary work. The urine is tested daily. On this diet thirst and polyuria diminish very rapidly and generally in a week's time glycosuria stops. In such cases the diet is gradually increased. If glycosuria pesists for 3—4 weeks and ketone bodies are found in urine insulin is given.

If on increasing a ten-line diet glycosuria again comes in insulin must be given. The scheme advocated by Lawrence is that of moderate Carbohydrate intake. It provides 120—200 gms. of carbohydrates (average) and in severe cases moderate amount of insulin may be used along with it.

Another way of treating a patient with maintenance diets is as follows :—

(1) First calculate the caloric needs of the

patient a man weighing 60 Kilos needs 60x35 C=2100 calories per day if he is a sedantary worker.

(2) Provide for at least 100 gms. of carbohydrate in the daily diet. This gives 410 calories.

(3) Provide for the necessary daily requirement of protein at 1 gm per kilo or 60 gms. This will give 246 calories.

(4) The rest of the calories 2100—(246+410) =1444 calories must come from fat. Each gram of fat gives 9·1 calories, so 158 gms. of fat will be needed.

The whole diet is divided into 3—4 portions and the carbohydrates are spread equally over the four meals. Mild cases yield to this treatment otherwise insulin must be used. Gradually carbohydrates in the diet are increaed.

J. P. Bose's Formula.—Basal metabolic needs of a diabetic is calculated at 25 calories per kilo of body weight. This total caloric requirement divided by 16 gives the amount of fat individual

requires in grammes ; the same divided by 16 gives the amount of carbohydrate in grammes and when divided by 20 gives the amount of protein in grammes.

Joslin Treatment.— Dr. Joslin of America dealt with recent cases of diabetes mellitus as follows :—

(1) The patient is given a diet containing about 20 calories per kilo of body-weight with carbohydrate at 100—150 gms, protein 50—60 gms, fat between 60—80 gms. If on this diet sugar persists in the urine he is given insulin and diet is gradually increased till he gets 30 calories per kilo, then he is sent home.

"High fat" diet of Newberg and Marsh.— This is low carbohydrate diet 30—40 gms carbohydrate a day. It may give rise to acidosis.

Woodyatt's Treatment.—In this form of treatment the ketogenic component of the diet are balanced by the requisite amounts of anti-ketogenic component—the glucose so as to prevent acidosis. The total quantity of fat in diabetic diet should

not exceed twice the amount of carbohydrate plus half the amount of protein in grammes. The total available glucose in the diet may be calculated as 100 % of the carbohydrate plus 58 % from the protein and 10 % from the fat.

Rabinowitch High Carbohydrate and low fat diet and a low Caloric diet.—The high carbohydrate intake under certain conditions stimulate the islet cells of the pancreas to increased activity whereas a very low carbohydrate diet lowers the tolerance of carbohydrates. Joslin is of opinion that if a diabetic patient is given less carbohydrate than his real tolerance allows, the carbohydrate tolerance will gradually fall through disuse, and sometimes it may be very difficult to raise it again. The patient feels happy and comfortable and there is an increased sense of physical and mental activity.

Qualitative Diet.—In some very mild cases diets containing approximately 100 gm carbohydrates and average amount of protein and fats is given. The food is not weighed. Carbohydrate rich food, such a sugar, jams sweets are stopped entirely and bread, potatoes etc. are given in fairly

exact amounts. The total content of carbohydrates does not exceed 100 gms a day.

The five-gram Diet Scheme.—Leyton, Lawrence and Harrison elaborated this scheme to enable an accurate and varied diets to be calculated with the minimum of trouble. According to whether they chiefly consist of carbohydrate, protein and fat, foods have been arranged in three lists which give the weight of food containing 5 gm of carbohydrate, Protein or fat respectively. And because most carbohydrate foods also contain some protein and fat and most protein foods some fat, the number of protein and fat contained in the weight of food under carbohydrate column is listed in the columns of food containing protein and fat also. For tables larger works on Diabetes mellitus must be consulted.

CHAPTER XXIV

Diet in Kidney Disease

Albuminuria. It is only a symptom and its exact significance must be discovered before treatment is applied.

(1) Orthostatic albuminuria of yoיng persons requires no treatment.

(2) Cases of essential hypertension without renal disease may also suffer from albuminuria and protein restriction is useless.

(3) Albuminuria means so much loss of protein to the body. This can not be stopped by protein restriction in the same way as glycosuria is cured by restricted diet. On the other hand protein in the diet may have to be increased to make good the loss of albumin in the urine.

The principles of dietetic treatment of kidney disease are :—

(1) To avoid articles which may irritate the kidneys in the process of their excretion such as alcohol, condiments containing mustard, ginger ect.

(2) To give as much rest to the kidney by cutting down its excretory work.

ACUTE DIFFUSE GLOMERULO-NEPHRITIS.

(1) Restriction of fluid. As the kidney can not excrete water fluid intake must be restricted. For the first 3—4 days the total quantity of water in 24 hours should not exceed 1 pint. This is given in the form of orangeade, glucose water, barley water etc.

(2) Restriction of Salt. The diet must be salt free.

(3) Meat, vegetable soups, eggs, alcohol, tea, coffee, fish, pickles, cheese are forbidden.

(4) After 3—4 days when the acute symptoms have subsided the diet is increased to meet the basal metabolic needs. The protein is kept low 30—40 gms a day and a diet high in carbohydrates is given. Fat 50 grames a day is given. Bread and butter, toast, potatoes, green vegetables, porri-dge, rice may be given.

(5) When the kidneys regain their power of

excreting nitrogen, proteins in the diet are increased. Meat and fish may be added to the diet if desired.

(6) Diet should be sufficient in caloric value about 2200—2400 calories a day to avoid destruction of body tissues.

Chronic Diffuse Glomerulonephritis

The dietetic management depends on the stage of the disease. The disease is divided into 3 stages :—

(1) Latent stage. In this stage there is minimal and irregular proteinuria, occasional haematuria and a tendency to slight dependent edema or morning facial edema. Dietary restrictions are not needed during this stage. A normal, well-balanced diet is quite enough. When edema is present salt and fluid intake should be restricted.

(2) Nephrotic stage. There is albuminuria and massive edema. The diet must be rich in proteins in order to compensate for the loss of albumin in urine. Proteins at least 125 gm per day are needed. Salt and water are restricted. Milk, meat and fish are allowed. Cereals, vegetables and fruits are given.

If proteins in the diet are insufficient body will be in negative nitrogen equilibruim. Body tissues will undergo wastage and the kidneys will deteriorate High protein diet will save the body proteins from destruction. High protein diet reduces edema in the following ways :—

(1) High protein diet raises the osmotic tension of plasma proteins, low osmotic tension of plasma is the cause of edema.

(2) Protein is changed in to urea which acts as diuretic.

Alcohol, condiments and spices are for bidden.

(3) Terminal stage. In this stage there is renal insufficiency and hypertension.

The patient must be studied from the following points :—

(1) State of hydration of tissues.

(2) Knowledge of plasma protein.

(3) Electrolyte and protein loss.

(1) State of hydration of tissues. The power of absorption of water in the kidney tubules is

greatly damaged. The patient suffers from polyuria and nocturia which prove exhausting and cause marked loss of water and electrolytes from the body. There is danger of dehydration which often develops insiduously. Increase intake of water is necessary in such cases. If oral replacement is impossible or inadequate normal saline with 5 per cent. glucose, normal saline or glucose 5 per cent. or sodium lactate solution or sodium bicarbonate solution may be required intravenously.

(2) Knowledge of plasma proteins. If there in retention of nitrogen in the blood, restriction of food nitrogen is necessary. If blood nitrogen is over 100 mg per 100 cc a low protein diet containing about 35—40 grammes of protein is given daily. Pork, beef, chicken, duck and veal are avoided. Milk and eggs are given,

(3) Electrolyte and protein loss. There may be several types of electrolyte imbalances :—

(1) Anion loss. Sodium chloride and water may be lost in excess from the body. In such cases water and salt must be replaced.

(2) Cation loss and Acidosis. The tubules

lose their ability to manufacture ammonia and to conserve the base from excretion, which leads to acidosis.

The treatment must be directed towards alkalinizing. But caution is necessary as the normal power of equilibrium is lost. Sodium lactate—Ringer solution and sodium bicarbonate are given. To avoid acidosis the diet should be poor in acid—forming foods. Most meats are highly acid forming so vegetable proteins are preferred to animal proteins. Milk and eggs are allowed.

Anion retention. Chloride and phosphate are commonly retained which also helps to bring about acidosis by increasing the concentration of acidions and by stimulating water and base loss. Phosphate retention leads to hypocalcemia as a result of the reciprocal relation between the calcium and phosphorus concentrations, calcium is lost in the stool and is precipitated from the blood into soft tissues symptons of rickets and osteomalacia, tetany, muscular twitching and cramps may appear. Growth may be stunted in children in cases of long standing. An alkaline ash diet, high calcium intake and vitamin D are required. Alkaline ash

forming foods are,—milk and cream, fruits and vegetables.

Cation Retention. The retention of cations in unusual. In very advanced cases potassium, may be retained in the body to give rise to toxic symptoms.

III Chronic Interstitial Nephritis.

In this condition blood urea is raised. A high caloric diet with low protein is given but the patient must be kept in nitrogen equilibrium. Alcohol is forbidden. There is tendency to acidosis also and therefore acid forming foods like meat should be avoided and alkalie forming foods like vegetables should be allowed. Alkalies by mouth may be given.

Water retention is absent. So fluid intake should be increased to two pints a day or even 3—4 pints a day.

CHAPTER XXV

Diet in Tuberculosis and Respiratory Diseases

In tuberculosis the aim of diatetic management should be to help the patient in maintaining the average weight. A high caloric diet to fatten the patient excessively is not needed. Ordinary well balanced diet is required. At one time high protein diet or a high fat diet were in vogue in the treatment of tuberculosis. In febrile cases high caloric diet is necessary to compensate for the increased metabolism and the diet given is as in any other fever.

If the patient is under weight, there is a need of food in excess of normal body requirements, to provide for storage of fat. So a high caloric diet is given, rich in fat and carbohydrates. The content of vitamin B, is increased in the diet to stimulate appetite and to help the utilisation of carbohydrates. Small, frequent feeds of easily digestible and palatable food are given, extra amounts of vitamins, A & D are essential, at least 9000 units of A and 1200 units of D are given daily. In wasting diseases, milk, cream, sugar and eggs are especially helpful.

Pneumonia.—The diet in this disease should be on the same principles as in any other acute febrile disorder. Overloading of the stomach is avoided. The diet should be mainly fluid.

Asthma.—It is often a manifestation of food allergy so offending articles of diet should be discovered and avoided.

Bronchitis, Tracheitis, catarrh of the nose. Hot drinks are sipped frequently. The diet should be easily digestible.

Pleurisy with effusion.—Salt is restricted. An adequate quantity of milk about 24—32 ounces daily is essential. Diet should be easily digestible.

CHAPTER XXVI

Diet in Skin Diseases

Vitamin A. It is useful in follicular hyper keratosis, keratosis pilaris, pityriasis rubra pillars, keratosis follicularis, and loss of skin tissue as from burns and ulcers. The daily dose should be 200,000 units.

Vitamin B Complex. In acrodynia injections of vitamin B, 6 mg daily for six days are reported to be useful. Riboflavin is useful in keratotic plugging of the seborrhoeic area of the face, when given in doses of 20 mg daily. Riboflavin with dilute hydrochoric acid is useful in the skin eruptions and keratitis of acne rosacea.

Skin manifestations of pellagra yield to niacin. Niacin is also of value in the acute pyogenio infection.

Pyridoxin has been recently reported to be useful in acne.

Vitamin C has proved useful in certain types of hyperkeratotic lesions, petechial hemorrhages. (Crandon). Vitamin C also prevents toxic effects

of arsenicals in the treatment of syphilis. It also helps the removal of melanin deposition of Addison's disease. (Cornbleet).

Urticaria.—It is very commonly a manifest action of food allergy. The offending article of diet should be avoided.

Eczema.—Like urticaria it may be a manifestation of food allergy,

Acne Vulgaris and Seborrhoea. These are made worse by diet rich in fats and carbohydrates. The diet should be rich in green vegetables, fruits and lean meat.

In rosacea alcohol, tea, coffee, condiments or anything causing flushing of the face must be avoided.

CHAPTER XXVII.

Diet in Diseases of the Nervous System.

Nervous symptoms are present in deficiency diseases like pellagra and rickets, Vitamin B_1. deficiency. The underlying cause of deficiency should be removed and these cases are benefitted with diet rich in vitamins. In typhoid fever, cerebral manifestations are benefitted by giving nicotinic acid. Nervous symptoms of pernicious anaemia respond to Liver. Therapy. Neurasthenic and anxiety states, respond well to an easily assimilable, rich, nourishing diet.

Some persons get attacks of spontaneous hypoglycemia. These are characterised by weakness, slight disturbance of consciousness and anxiety like states. These attacks are controlled by use of sugars. Small carbohydrate feeds may be given midway between the principal meals to prevent these attacks.

Epilepsy. Epilepsy, has been treated with a diet rich in fat called ketogenic diet. In these diets, the carbohydrate is reduced to the lowest practical minimum (10—13 grammes) and the fat

is greatly increased, which results in an incomplete oxidation of the fat, producing a ketosis. Such diet may become deficient in minerals and vitamins which must be added to the diet as medicaments.

The patient is kept in bed for a week and given only water, gravy soup, bran biscuits and a little orange juice. Then a diet sufficient for basal metabolic requirement is calculated. The protein contents of this diet should be approximately of body weight 1 gramme per kilogramme, carbohydrates 10—13 grammes and the rest of the calories made up with fat. The diet is given until the fits cease and then it is continued for another 3 months, when carbohydrates are gradually increased and fats decreased.

For ketogenic diet milk can not be used because of the amount of carbohydrate that it contains Cream is given for its high fat and low carbohydrate content. Cheese may be given as it contains little or no carbohydrate.

Meat, fish, eggs and chicken may be given but in small quantities.

Butter or fortified vegetable oils or oleomar garine is given liberally.

Vegetables and fruits are given in sparing amounts

Breads and cereals are not given because of high carbohydrate contents Agar and washed brawn may be given to increase the bulk of the diet.

Ketogenic diet was once used for infections of the urinary tract also but now it has been given up for mandelic acids and sulfonamides.

CHAPTER XXVIII

Diet in Rheumatism and Gout.

(1) Gout. The Pathology of gout is still obscure. It is intimately connected with the metabolism of Uric acid. Excess of fat in the diet also precipitates an attack of gout. So the indications for the dietetic management of gout are :—

(1) To reduce the intake of food rich in purines.

(2) Alchol is forbidden.

(3) Tea, Coffee, Cocoa. These were totally forbidden formerly. They contain methyl purines which do not increase the out put of uric acid in health. They may be allowed in moderation.

(4) During the attack excess of sodium chloride in the diet is avoided since the sodium salts lessen the solvent power of the serum for sodium hiurate.

(5) Excessive fat in the diet is avoided. It may precipitate an acute attack during the latency

of the disease. Fat probably interferes with the excretion of uric acid from the body.

(6) During the acute attack only purine free foods are allowed.

(7) In convalescence from an acute attack, or if the patient is liable to frequent attacks foods allowed should be either purine free or contain less that 0·07 gramme of purines for 100 grammes. These are :— Bacon, Pork, Ham, Cod, Crab, Beef, Beans, Brains, Bread, Eggs, Flour and other cereals, Green leaf vegetables Nuts, Peas, Root vegetables (Purin less than 0·07 gms per 100 gms.)

Foods free from Purines are :—

Butter, Cheese, Cream, milk, fruits Honey, Jam, Marmalade, Sugar and vegetable soups.

(8) In the long intervals between the attacks foods which contain purin less than 0·1 gramme per 100 grammes are allowed.

Foods containing purins less thad 0·1 gramme per 100 gms but more than 0·07 grammes per 100 gms are :—

Goose, venison, Pheasant, Trout, whiting, Veal Mutton, Salmon, Haddock, Chicken, Pollock.

Foods rich in purines are :—Herring Roe, Sweet breads, whitebaits, sprats, Sardines, Heart, Herring Mussels, Liver, Kidney, Bloater, Goose. Beverages Rich in Purines are ;—Cocoa, Coffee, Chocolate, Meat extracts, Meet Soups, Tea.

II. Rheumatoid Arthritis, Arthritis, Oseto Arthritis, Fibrosities.

A raw vegetable and fruit diet is said to be beneficial. Probably good results are due to excessive amount of vitamin C so taken.

In rheumatoid arthritis the indications are :—

(1) Any obesity present must be corrected.

(2) Carbohydrates may be restricted to a reasonablə extent. Excess of sugar and starches is forbidden.

(3) Plenty of vitamins are given.

(4) A good supply of easily digested proteins.

(5) Adequate supply of Calcium and Iron.

Graval. Urates and Uric acid may be precipitated at body temperature in highly acid urine. The

indications are to make the urine less acid by giving alkalies or foods which produce alkalies like, fruit and vegetables (except Brussels syrouts). Foods producing acids should be decreased or stopped, such as meat and fish, bread, rice and oatmeal.

Oxaluria. Foods rich in Calcium and oxalates like milk, eggs, tomato, spinach rhubarb are avoided. Intestinal fermentation should be treated by a large intake of B. acid-ophilus milk over a long period.

Urinary Stones

Many recurrent stones are preventible if sufficient attention is paid to the causative factors after spontaneous passage or surgical removal of the stone.

Etiology of Urinary Stones

(1) Lack of vitamin A, and an ill balanced diet.

(2) Urinary stasis and infection of the urinary tract.

(3) Distant Septic foci.

(4) A deficient water intake.

(5) Metabolic disorders like cystinuria and xanthinuria, hyperparathyroidism, gout, oxaluria, Alkalinuria accompanied with phosphaturia and calcinuria.

(6) Peptic ulcer with prolonged antacid treatment.

(7) A long period of recumbency.

Following are the most important dietetic indications for the prevention of Urinary calculi.

(1) Vitamin A. The most important single factor is the administration of vitamin A, a lack of which has got a definite relationship with calculous disease. At the Cleveland Clinic, the incidence of recurrent stone formation has been lowered from 16 % to 4·9 % with the use of vitamin A rich and acid ash diet (Higgins).

(2) Deficient water intake. A water intake of at least sixty ounces a day is advisable to promote mechanical flushing and to ensure ample water for

solubility of urinary solids. Very hard waters with high calcium content should be avoided.

(3) For cystinuria and xanthinuria. Alkalinization of the urine and dietary restrictons are indicated.

(4) Gout and hyperparathyroidism must be treated.

(5) Oxaluria. Dietetic management has already been described.

(6) Alkalinuria. Persistent alkalinuria is practically always associated with hyperchlorhydria which should receive attention.

CHAPTER XXIX.

Artificial Feeding.

(1) Rectal feeding and Nutrient enemata. Substances like peptones, eggs. raw beef juice, starch and fat are not absorbed from the large intestines. Nitrogen is absorbed only in the form of amino acids and therefore if nitrogen is to be given it must be given in the form of amino acid or milk pancreatized for twentyfour hours.

(2) Carbohydrates Glucose alone is absorbed but it should not be given in concentrated form. 6 percent glucose in normal saline, Ringer's solution or ordinary water may be given. 600 cc may be given every 4 hours or 100.cc per hour by drip method.

(3) Salts. Sodium chloride is also absorbed if given in the form of normal saline or Ringer's solution.

Nutrient Suppostories are useless.

Subcutaneous Feeding

Practically speaking only sodium chloride and glucose can be given by this route. Though the

proteins in the form of serum or fats in the form of olive oil can be given and are absorbed but they are risky. Glucose 4 per cent in Ringer's solution or normal saline is given and as much as 3500 cc may be given in 24 hours. Intravenous route is however to be preferred and is largely used now.

(4) Gavage and forced feeding. In this method food is artificially introduced in to the stomach by a tube which may be passed through the mouth or nostril in to the œsophagus or stomach. In case of œsophageal obstruction feeding may be done through the gastrostomy wound or jejunal feeding may be required after a jejunostomy. Milk, eggs beaten with milk, sugar and cream are quite suitable. About 8 ounces may be given every 3—4 hours.

Protein.—Protein is given intravenously in the form of human plasma, human albumin, whole blood, purified gelatine, hydrolysates of casein (mixtures of amino acids). The amino acid mixtures by intravenous route has lately attracted attention. It is finding increasing field of utility every day. Amino acid mixtures are used in 2·5—5% strength diluted with 5—10%

dextrose solution. Local .venous thrombosis, nausea, vomiting and fever have been reported after their use. Mixtures of purified essential amino acids have also been given to human beings and are well tolerated. This has now made possible the administration of an almost complete diet without recourse to the usual digestive process. Thus starvation can be avoided almost completely even though it is impossible to take any thing by the mouth.

Complete rest of the gastro intestinal tract, which heretofore inevitably resulted in protein starvation, can now be achieved with an almost full dietary intake.

One liter of amino acid mixtures is given at a time, morning and one in the after noon. The rate of injection must be slow. For one liter two hours are taken because at least full two hours are required for full utilization of the injected glucose and amino acids.

Subcutaneous injection.—Amino acids may be injected subcutaneously also. The strength of the solution like glucose solution, should be isotonic with the blood and neutral in reaction. Solution

should contain $2\frac{1}{2}\%$ of amino acids and $2\frac{1}{2}\%$ glucose.

Indications for parenteral use of amino acids. The use of amino acids by parenteral route is indicated whenever there is a failure in normal ingestion, digestion and absorption of food proteins. We have come to realize the importance to supply the daily needs of vitamins, salts and glucose by injection in so many cases but have not yet realised the necessity to supply the proteins in a similar way. Proteins cannot be stored and so amino acids must also be given whenever glucose or saline are required. Special indications for parenteral protein therapy are :—

(1) Patients unable to ingest protein because of vomiting or gastro intestinal diseases like intestinal obstruction, peritonitis, acute cholecystitis, peptic ulcer, cancer or preoperative and post operative cases in which gastro intestinal rest is indicated.

(2) Cases of advanced inanition, amino acid therapy recently has been shown capable of saving many lives from the late or the irreversible stage of

starvation. After a certain point in progressive starvation death cannot be averted because the gastro intestinal tract becomes incapable of function. Fluid or food cannot be swallowed or if given by the tube is vomited out or rejected in diarrhoea, it is not utilised. Krishnan in recent famine in India (1943) saved many lives by the intravenous use of hydrolysed protein and glucose Such lives would have been lost under the old regime. Injections of glucose alone, or of saline solution, plasma or blood proved relatively ineffective. Only a few injections, averaging three, of the hydrolyzed protein solution were necessary. After this treatment patients were revived and able to start taking food and fluid by mouth.

(3) Patients in whom there is relative difficulty in ingestion, digestion or absorption of proteins. In these cases protein deficiency will arise, hypoproteinæmia and edema may result which will aggravate the condition. Such cases are seen after severe injuries especially fractures, burns, ulcerative colitis, regional colitis, and intestinal fistuals.

(4) Allergic cases and cases of bleeding peptic ulcer.

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